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**Intermountain
Research Station**

General Technical
Report INT-246

June 1988

Atlas of 28 Selected Commercial Forest Areas With Unutilized Stands of Lodgepole Pine

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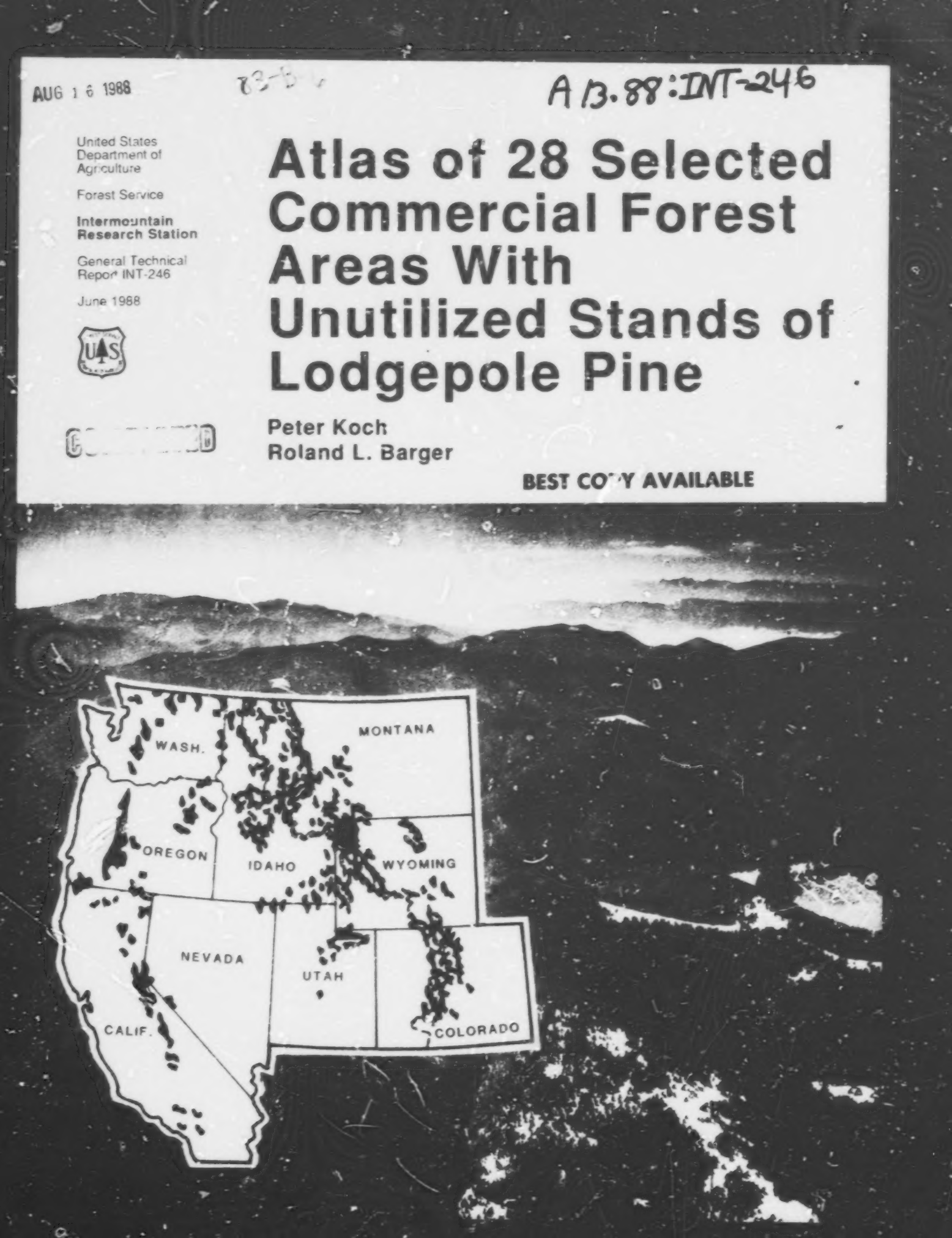

METRIC CONVERSION FACTORS

English units to metric			Metric units to English		
LENGTH					
1 in	=	25.4 mm (exactly)	1 mm	=	0.0393701 in
1 in	=	2.54 cm (exactly)	1 cm	=	0.393701 in
1 ft	=	0.3048 m (exactly)	1 m	=	3.28084 ft
1 yd	=	0.9144 m (exactly)	1 m	=	1.09361 yd
1 chain (22 yd)	=	20.1168 m (exactly)	1 m	=	0.0497097 chain
1 mi	=	1.60934 km	1 km	=	0.621371 mi
AREA					
1 in^2	=	645.16 mm^2 (exactly)	1 mm^2	=	0.0015500 in^2
1 in^2	=	6.4516 cm^2 (exactly)	1 cm^2	=	0.15500 in^2
1 ft^2	=	0.0929030 m^2	1 m^2	=	10.7639 in^2
1 yd^2	=	0.836127 m^2	1 m^2	=	1.19599 yd^2
1 mil-acre	=	4.04686 m^2	1 m^2	=	0.247105 mil-acre
1 acre	=	0.404686 ha	1 ha	=	2.47105 acres
1 mi^2	=	2.58999 km^2	1 km^2	=	0.386102 mi^2
VOLUME OR CAPACITY					
1 in^3	=	16,387.064 mm^3	1 mm^3	=	0.000061024 in^3
1 in^3	=	16.38706 cm^3	1 cm^3	=	0.061024 in^3
1 ft^3	=	0.0283168 m^3	1 m^3	=	35.3147 ft^3
1 yd^3	=	0.764555 m^3	1 m^3	=	1.30795 yd^3
1 cunit (100 ft^3 of solid wood)	=	2.83168 m^3	1 m^3	=	0.353147 cunit
1 cord (128 stacked ft^3)	=	3.62456 m^3 (stacked)	1 m^3 (stacked)	=	0.275896 cord
1 bd ft	=	0.002359738 m^3	1 m^3	=	423.7759 bd ft
1 gal (US)	=	3.785412 L	1 L	=	0.264172 gal (US)
MASS OR WEIGHT					
1 grain	=	0.064799 g	1 g	=	15.4324 grains
1 oz	=	28.3495 g	1 g	=	0.035274 oz
1 lb	=	0.453592 kg	1 kg	=	2.20462 lb
1 ton (short)	=	907.1847 kg	1 kg	=	0.0011023 ton (short)
1 ton (short)	=	.907185 t	1 t	=	1.10231 tons (short)
1 ton (long)	=	1.01605 t	1 t	=	0.98420 ton (long)
PRESSURE					
1 lb f/in^2	=	6.8966 k Pa	1 k Pa	=	0.1450 lb f/in^2
RATIOS					
1 ft^3/acre	=	0.229568 m^3/ha	1 m^3/ha	=	4.35600 ft^3/acre
1 ft^3/acre	=	0.0639725 m^3/ha	1 m^3/ha	=	14.2913 ft^3/acre
1 cord/acre	=	8.95647 m^3 (stacked)/ha	1 m^3 (stacked)/ha	=	0.111651 cord/acre
1 lb/ft^3	=	16.0185 kg/m^3	1 kg/m^3	=	0.0624280 lb/ft^3
1 ton (short)/acre	=	2.24170 t/ha	1 t/ha	=	0.446090 ton (short)/acre
1 mi/gal (US)	=	0.425143 km/L	1 km/L	=	2.35215 mi/gal (US)

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The authors acknowledge with appreciation the generous cooperation of the managers of the 28 forest areas studied.

RESEARCH SUMMARY

This atlas provides maps and general descriptions of a single representative problem area of more-or-less contiguous acreage within each of 28 public forests (National, Bureau of Land Management, and State) where increased utilization of lodgepole pine is desired by the forest manager. The 28 areas total 646,401 acres. Most of the lodgepole pine volume is of subsawlog size.

The managers of these areas face the problem of how to clearcut and regenerate large acreages of stagnated or otherwise unproductive stands of lodgepole pine without expenditure of public funds to cover the direct costs. Additionally, managers must accomplish this stand replacement according to a management plan without jeopardizing the other values of the forest—that is, wildlife habitat, stream quality, and esthetic quality.

Gross characteristics of a pair of trees 3½ to 4 inches in d.b.h. sampled from each area are presented. The sample trees averaged 87 years of age, about 35 feet in height, and had an average crown ratio of about 46 percent. Height from stump top to base of the live crown averaged 228 inches and below-crown stem taper (inside bark) averaged 0.60 inch/100 inches. Stem sections sampled at 20 percent of tree height, lathe-turned to 2¼ inches in diameter, and air dried had mechanical properties in compression parallel to the grain as follows (values adjusted to a moisture content of 10 percent of ovendry weight): modulus of elasticity, 1,190,000 lb f/in²; maximum crushing strength, 5,760 lb f/in²; proportional limit, 3,850 lb f/in². At 20 percent of stem height, stemwood moisture content averaged 95 percent of ovendry weight, and stemwood specific gravity averaged 0.42 based on ovendry weight and green volume. Among specimens drawn from the seven States in the study, Montana specimens had highest mechanical properties.

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CHAPTER 1: GENERAL INFORMATION

INTRODUCTION

Lodgepole pine (principally *Pinus contorta* var. *latifolia* Engelm.) occupies about 13 million acres of commercial forest land in the United States—mostly in the Intermountain West (fig. 1-1). Much of this resource is in older (60 to 200 years), virtually stagnated stands in which growth rate is very slow and mortality very high. Insect and disease attacks on lodgepole of sawlog size make growing large-diameter trees a difficult and uncertain undertaking. More than half the lodgepole pine stemwood cubic volume in the Intermountain West is in trees of subsawlog size. About one-third of the volume is on slopes exceeding 45 percent, and many of the stands are not accessible from existing logging roads.

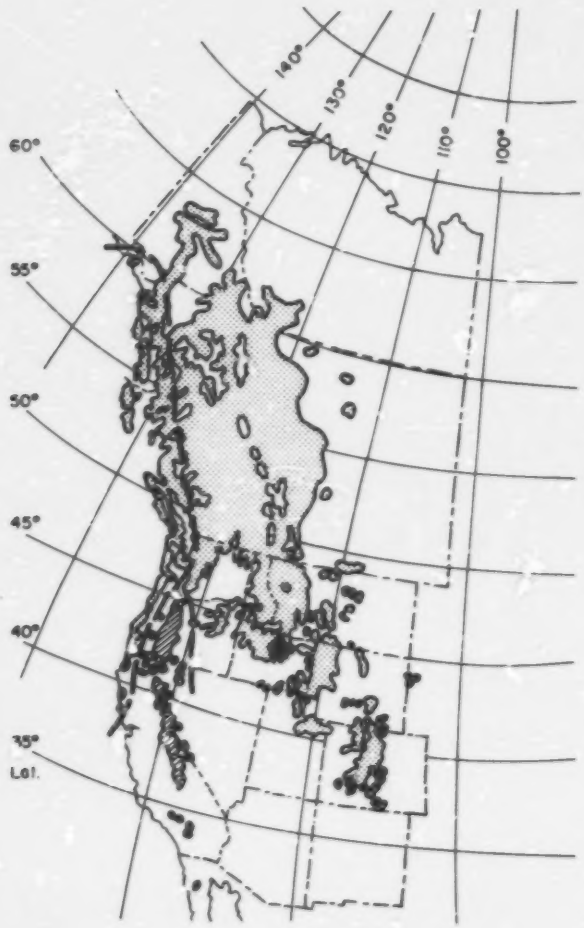

Figure 1-1—Range map of lodgepole pine in North America (Little 1971). Variety *latifolia* is mapped to the right of the dashed lines, variety *murrayana* (Grev. & Balf.) Engelm. between them, and variety *contorta* to the left of them.

In the Interior West, lodgepole pine represents the single most significant opportunity for improving both wood resource utilization and forest land management. Two concerns have focused increasing attention on improving harvesting and utilization opportunities in these stands. The first is a concern about our continuing ability to meet national demands for wood and wood-based products, especially softwood construction materials. Predictions forecast a growing gap between supply and demand, a situation that can be partially circumvented by placing currently untreated timberlands under more intensive management. Overmature and stagnated lodgepole pine occupies millions of acres of commercial forest land that will remain essentially nonproductive until present stands are harvested. A second concern is the need to achieve broad resource management and objectives relating to protection from insect, disease, and fire. Particularly urgent is the need to implement management strategies that will reduce the probability of mountain pine beetle epidemics in the future.

Silvicultural treatments (thinning or removal and regeneration to managed stands with controlled stocking) are so expensive, and stumpage revenues so little, much of the acreage has received no treatment to accelerate growth and to slow mortality. Present lack of technically and economically viable utilization alternatives precludes profitable harvest of lodgepole pine in quantities sufficiently large to effectively manage the acreage they occupy. The primary problem, therefore, is to invent processes that will permit large-scale profitable utilization of lodgepole pine of all diameter classes on all terrains, and to effectively disseminate information about the new processes. The ultimate goal is to assure that manufacturing facilities are constructed to employ the processes and that forests of increased productivity are thereby regenerated.

Prior experience suggests that such process invention is most likely to occur if:

- the extent of the resource is fully understood
- full characterization data on lodgepole pine wood, bark, and foliage as industrial raw materials are readily available to process engineers and scientists
- the world literature on lodgepole pine is collected, keyworded, and made easily available
- a representative group of key lodgepole pine acreages for which responsible land managers seek intensified utilization are defined and thoroughly described in publications readily available to entrepreneurs as well as to process engineers.

The Forest Survey units of the Intermountain and the Pacific Northwest Research Stations, Forest Service, U.S. Department of Agriculture, have responsibility for developing timber resource data for the area of the United States in which lodgepole pine occurs. Relatively detailed resource information for lodgepole pine, including volume data by diameter class and geographic area, is available from the Intermountain Station for Idaho, Montana, Wyoming, Utah, and Colorado, and from the Pacific Northwest Station for Oregon and Washington.

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Gross characteristics of lodgepole pine trees in North America, including a review of the world literature, are provided in General Technical Report INT-227 (Koch 1987) available from the Intermountain Research Station. Similar reports—with literature reviews—on detailed anatomical, chemical, permeability, and mechanical-property characteristics of lodgepole pine are being prepared by various university researchers under cooperative agreements with the Intermountain Research Station. Manuscripts for these reports are all scheduled for completion before the end of 1988.

For ready retrieval by researchers, the world literature on lodgepole pine has been collected, keyworded, filed, and essential data inserted in a computerized data base presently housed at Wood Science Laboratory, Inc., Corvallis, MT. The data base is accessible to the public through the Intermountain Research Station.

OBJECTIVE AND SCOPE

This General Technical Report provides general descriptions of a single representative problem area of more-or-less contiguous acreage within each of 28 public forests (National, Bureau of Land Management, and State) where increased utilization of lodgepole pine is desired by the forest manager (table 1-1 and fig. 1-2). Trees on each of these areas could be harvested and marketed over the next several decades according to management plans if

Table 1-1—Summary data on 28 selected acreages representing the unutilized lodgepole pine resource

State and Forest	Ranger District	Area name	Average elevation	Gross area	Age[1]	D.b.h.[2]	Access[3]	Terrain[4]
			Feet	*Acres*				
Colorado								
Gunnison	Taylor River	Taylor Lake	10,500	110,000	3	1+2+3	1	1+2
Rio Grande	Saguache	Sheep Creek	9,750	16,500	3	1+2	1	2
White River	Holy Cross	Tennessee Pass	9,500	28,000	3	1+2	1	2
State Forest	---------- southern end ----------		9,500	16,000	3	1+2	1	2
BLM	Montrose	Rock Creek	10,200	8,900	3	1+2+3	2+3	2
Idaho								
Caribou	Soda Springs	Brockman Road	7,000	27,000	1+2	1+2	1	2
Challis	Yankee Fork	Cape Horn	6,800	3,400	2+3	1+2	1	1
Nez Perce	Elk City	Kirks Fork	5,000	5,040	2	1+2	2	2
Panhandle	Avery	Wampus, etc.	6,000	3,900	2	1+2	2	3
Payette	McCall	Stratton Creek	6,700	7,800	3	2+3	2	2
Salmon	Cobalt	Leesburg Basin	7,300	31,700	2+3	1+2+3	1	2
Montana								
Deerlodge	Deerlodge	Cottonwood Creek	6,500	3,000	2+3	1+2	1	2
Flathead	Tally Lake	Good Creek Burn	4,800	16,000	2	1+2	1	2
Gallatin	Bozeman	Goose-Levinski	7,800	7,000	2+3	1+2	2	3
Helena	Lincoln	Poorman Creek	6,400	25,000	2+3	1+2	1	2+3
Kootenai	Yaak	Zulu-Smoot	5,000	5,000	2	1	2	2
Oregon								
Fremont	Paisley	Witham	7,200	16,000	3	1+2+3	1+3	2
Malheur	Long Creek	Crawford Meadow	5,400	4,251	2	1+2	1	1
Mount Hood	Clackamas	Pinhead Butte	4,200	3,910	2+3	2+3	1	2
Utah								
Ashley	Vernal	Alma Taylor	9,000	16,000	2+3	1+2	1	1
Washington								
Colville	Colville and others	Pend Oreille River-Ruby Creek	4,000	40,000	2	1+2	1	2
Okanogan	Tonasket	Meadows Area	6,000	89,000	3	1+2	1	2
Wenatchee	Entiat	Big Creek-Lake Creek	5,000	2,000	3	1+2	2+3	3
State Forest	Northwest	Loomis Block	5,800	2,120	3	1+2	3	2
Wyoming								
Bighorn	Buffalo and Tongue	Piney Creek-Rock Creek	8,500	75,000	3	1+2	3	2
Bridger-Teton	Pinedale	South Wind River	8,800	41,000	3	2	2+3	2
Medicine Bow	Laramie	Upper Pelton Creek	9,000	7,830	3	1+2	1	2
Shoshone	Lander	Grannier Meadow-Dickinson Park	9,000	35,000	3	1+2	1	2

[1] 1 = <50; 2 = 50-80; 3 = 80+ years.
[2] 1 = sapling/pole <5.0 inches d.b.h.; 2 = pole/small sawtimber 5.0-8.9 inches d.b.h.; 3 = sawtimber 9.0+ inches d.b.h.
[3] 1 = accessed; 2 = perimeter access only; 3 = distance from roads.
[4] 1 = flat, <20 percent slope; 2 = mixed, with at least half <45 percent slope; 3 = predominantly steep, more than half 45 percent slope.

Figure 1-2—Representative problem areas—one within each of 28 forests (National, Bureau of Land Management and State)—where the forest manager desires increased utilization of lodgepole pine.

commercially viable utilization operations could be devised incorporating harvesting procedures that meet land managers' objectives within an acceptable budget. Distances from railheads nearest each area to major markets in the United States are shown in table 1-2.

Each area contains at least 2,000 acres (in total, the 28 areas comprise 646,401 acres), and each could be termed a "hopeless case" where in 1986 the manager could not visualize near-term marketing of the stumpage—under acceptable conditions—for conventional processing. The selected acreages have been limited to one per forest, and therefore comprise only a small percentage of the total problem acreages they represent in the lodgepole pine forests of the United States.

As funds are available, more detailed timber inventory data will be developed for each of the 28 sample areas. To the extent possible, secondary data sources (stand exam records, etc.) are being used as a basis for improved characterization of the resource. Inventory information will be made generally available through Intermountain Research Station publications.

Common names of tree species are used in the area descriptions that follow; corresponding scientific names are listed in table 1-3.

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Table 1-2—Highway distances from railhead towns adjacent to 28 selected areas to 16 cities representing major markets in the Midwest and East, West, and Southwest

State, Forest, and adjacent railhead	Midwestern and eastern cities					
	Boston	Chicago	Kansas City	Omaha	Rapid City	St. Paul
	Miles to major markets					
Colorado						
Gunnison (Salida)	2,072	1,154	681	675	532	1,010
Rio Grande (Salida)	2,072	1,154	681	675	532	1,010
White River (Leadville)	2,052	1,099	703	640	497	949
State Forest (Fort Collins)	1,942	989	665	530	330	828
BLM (Salida)	2,072	1,154	681	675	532	1,010
Idaho						
Caribou (Idaho Falls)	2,426	1,473	1,226	1,071	650	1,269
Ch[illegible]s (Boise)	2,639	1,683	1,382	1,227	906	1,445
Nez Perce (Grangeville)	2,673	1,710	1,580	1,335	831	1,315
Panhandle (St. Regis)	2,571	1,608	1,434	1,233	729	1,213
Payette (McCall vicinity)	2,747	1,791	1,490	1,335	921	1,405
Salmon (Darby)	2,565	1,602	1,428	1,227	723	1,207
Montana						
Deerlodge (Deer Lodge)	2,439	1,476	1,288	1,087	583	1,088
Flathea[illegible]itefish)	2,581	1,618	1,495	1,294	790	1,223
Gallatin ([illegible]man)	2,317	1,354	1,166	965	461	966
Helena [illegible]	2,301	1,425	1,251	1,050	546	1,030
Kootenai [illegible]	2,690	1,727	1,553	1,352	648	1,332
Oregon						
Fremont (Lakeview)	2,970	2,007	1,673	1,610	1,232	1,739
Malheur (Baker)	2,773	1,810	1,509	1,354	1,033	1,542
Mount Hood (Portland)	3,048	2,083	1,809	1,654	1,204	1,688
Utah						
Ashley (Park City)	2,313	1,360	1,056	901	632	1,163
Washington						
Colville (Cusick)	2,716	1,753	1,579	1,378	874	1,358
Okanogan (Omak)	2,835	1,872	1,698	1,497	993	1,477
Wenatchee (Chelan)	2,872	1,909	1,735	1,534	1,030	1,514
State Forest (Omak)	2,835	1,872	1,698	1,497	993	1,477
Wyoming						
Bighorn (Sheridan)	2,099	1,136	931	735	243	782
Bridger-Teton (Rock Sprin	2,163	1,210	906	751	528	1,049
Medicine Bow (Laramie)	1,956	1,003	699	544	344	842
Shoshone (Riverton)	2,154	1,201	907	739	387	915

(con.)

Table 1-2 (Con.)

State, Forest, and adjacent railhead	Western cities				
	Denver	Portland	Salt Lake	San Francisco	Seattle
	Miles to major markets				
Colorado					
Gunnison (Salida)	138	1,247	480	1,172	1,316
Rio Grande (Salida)	138	1,247	480	1,172	1,316
White River (Leadville)	103	1,232	465	1,157	1,301
State Forest (Fort Collins)	65	1,194	471	1,223	1,263
BLM (Salida)	138	1,247	480	1,172	1,316
Idaho					
Caribou (Idaho Falls)	655	693	219	859	762
Challis (Boise)	811	432	340	658	501
Nez Perce (Grangeville)	1,009	412	538	856	383
Panhandle (St. Regis)	962	475	585	1,082	405
Payette (McCall vicinity)	919	502	448	766	473
Salmon (Darby)	896	611	460	1,023	541
Montana					
Deerlodge (Deer Lodge)	818	624	459	1,075	554
Flathead (Whitefish)	1,025	610	653	1,144	540
Gallatin (Bozeman)	696	746	337	953	676
Helena (Helena)	781	658	477	1,098	588
Kootenai (Libby)	1,081	509	704	1,201	439
Oregon					
Fremont (Lakeview)	1,073	337	569	415	509
Malheur (Baker)	938	311	467	785	488
Mount Hood (Portland)	1,238	0	767	636	172
Utah					
Ashley (Park City)	474	797	30	782	866
Washington					
Colville (Cusick)	1,107	366	730	900	325
Okanogan (Omak)	1,226	388	849	1,019	236
Wenatchee (Chelan)	1,263	333	850	1,086	181
State Forest (Omak)	1,226	388	849	1,019	236
Wyoming					
Bighorn (Sheridan)	424	1,015	535	1,287	945
Bridger-Teton (Rock Springs)	356	906	180	922	975
Medicine Bow (Laramie)	149	1,110	387	1,139	1,179
Shoshone (Riverton)	395	1,028	321	1,063	1,097

(con.)

Table 1-2 (Con.)

State, Forest, and adjacent railhead	Southwestern cities				
	Dallas	Las Vegas	Los Angeles	Phoenix	Reno
	Miles to major markets				
Colorado					
Gunnison (Salida)	779	714	996	719	948
Rio Grande (Salida)	779	714	996	719	948
White River (Leadville)	839	699	981	763	933
State Forest (Fort Collins)	846	842	1,124	857	994
BLM (Salida)	779	714	996	719	948
Idaho					
Caribou (Idaho Falls)	1,430	650	932	867	630
Challis (Boise)	1,582	666	849	951	429
Nez Perce (Grangeville)	1,780	864	1,047	1,149	627
Panhandle (St. Regis)	1,737	994	1,259	1,233	853
Payette (McCall vicinity)	1,690	774	957	1,059	537
Salmon (Darby)	1,671	971	1,136	1,108	794
Montana					
Deerlodge (Deer Lodge)	1,591	890	1,172	1,107	846
Flathead (Whitefish)	1,798	1,059	1,324	1,298	918
Gallatin (Bozeman)	1,469	768	1,050	985	724
Helena (Helena)	1,554	908	1,190	1,125	869
Kootenai (Libby)	1,856	1,113	1,378	1,352	972
Oregon					
Fremont (Lakeview)	1,540	684	607	969	237
Malheur (Baker)	1,709	793	976	1,078	556
Mount Hood (Portland)	2,009	981	959	1,266	538
Utah					
Ashley (Park City)	1,272	463	745	678	553
Washington					
Colville (Cusick)	1,182	1,068	1,223	1,299	796
Okanogan (Omak)	2,001	1,187	1,342	1,472	915
Wenatchee (Chelan)	2,038	1,169	1,326	1,509	857
State Forest (Omak)	2,001	1,187	1,342	1,472	915
Wyoming					
Bighorn (Sheridan)	1,197	954	1,236	1,121	1,058
Bridger-Teton (Rock Springs)	1,125	613	895	828	703
Medicine Bow (Laramie)	918	806	1,088	843	910
Shoshone (Riverton)	1,116	754	1,036	969	844

Table 1-3—Common and scientific names of three varieties of lodgepole pine and some tree species frequently found in association with lodgepole pine

Common name	Scientific name
Bigtooth aspen	*Populus grandidenta* Michx.
Douglas-fir	*Pseudotsuga menziesii* (Mirb.) Franco
Engelmann spruce	*Picea engelmannii* Parry ex Engelm.
Grand fir	*Abies grandis* (Dougl. ex D. Don) Lindl.
Lodgepole pine	
Lodgepole pine	*Pinus contorta* var. *latifolia* Engelm.
Shore pine	*Pinus contorta* Dougl. ex Loud. var. *contorta*
Sierra lodgepole pine	*Pinus contorta* var. *murrayana* (Grev. & Balf.) Engelm.
Mountain hemlock	*Tsuga mertensiana* (Bong.) Carr
Ponderosa pine	*Pinus ponderosa* Dougl. ex Laws. var. *ponderosa*
Subalpine fir	*Abies lasiocarpa* (Hook.) Nutt.
Western hemlock	*Tsuga heterophylla* (Raf.) Sarg.
Western larch	*Larix occidentalis* Nutt.
Western redcedar	*Thuja plicata* Donn ex D. Don
Western white pine	*Pinus monticola* Dougl. ex D. Don
White fir	*Abies concolor* (Gord. & Glend.) Lindl. ex Hildebr.

TRANSPORT NETWORKS

The 28 areas are largely concentrated adjacent to the Continental Divide and at higher elevations between the Cascade Mountains and the Continental Divide (fig. 1-2). Most major markets are far to the east and south (fig. 1-3). Long-distance transport costs are therefore critical to profitable large-scale utilization of lodgepole pine for most purposes. Rail transport networks (fig. 1-4) are needed for long hauls to the Midwest, East, and South. Truck transport via the Interstate Highway System (fig. 1-5) may be economical for the closest midwestern, southwestern, and western markets (table 1-2). Transport by river network (fig. 1-6) is probably impractical with the possible exception of access to Pacific Rim markets from the head of navigation (Lewiston, ID) on the Snake River.

Additional comments on transport networks will be made in the general descriptions of the 28 areas, organized alphabetically by State, in table 1-1.

Figure 1-3—Population distribution in the United States.

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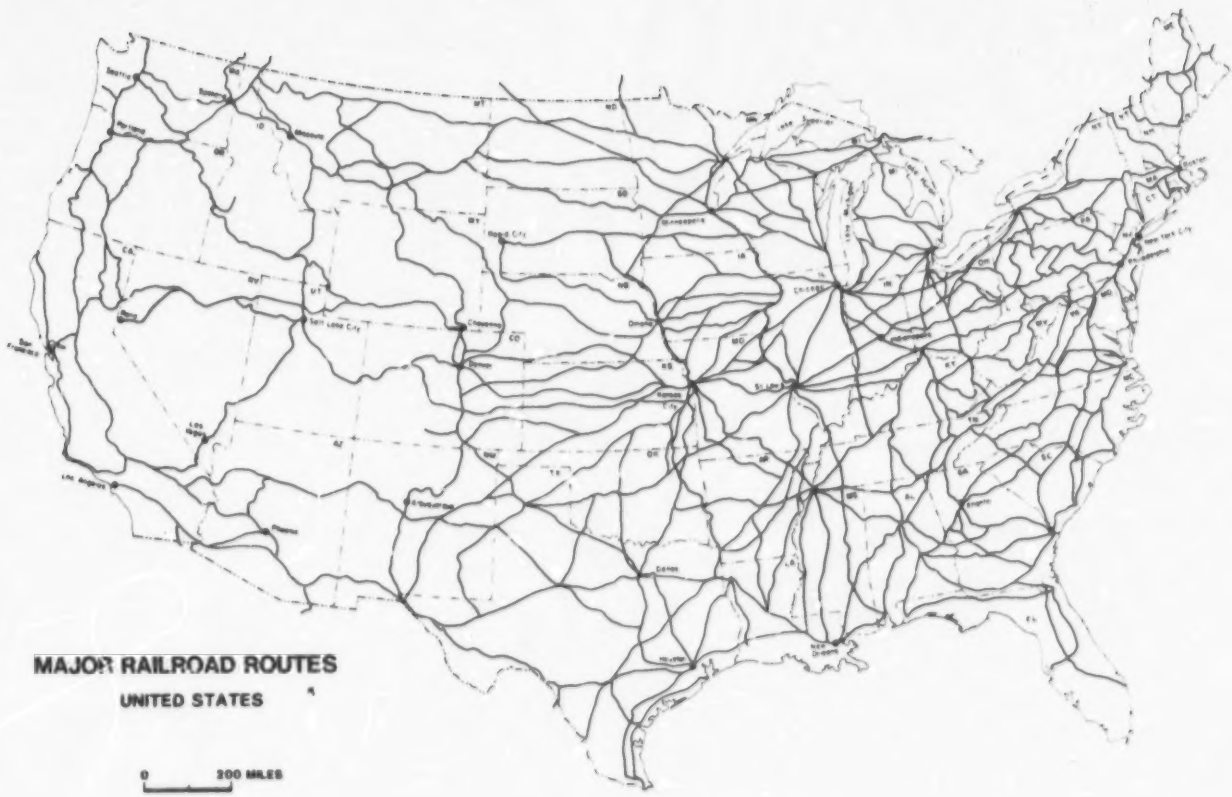

Figure 1-4—Major railroad routes serving the continental United States.

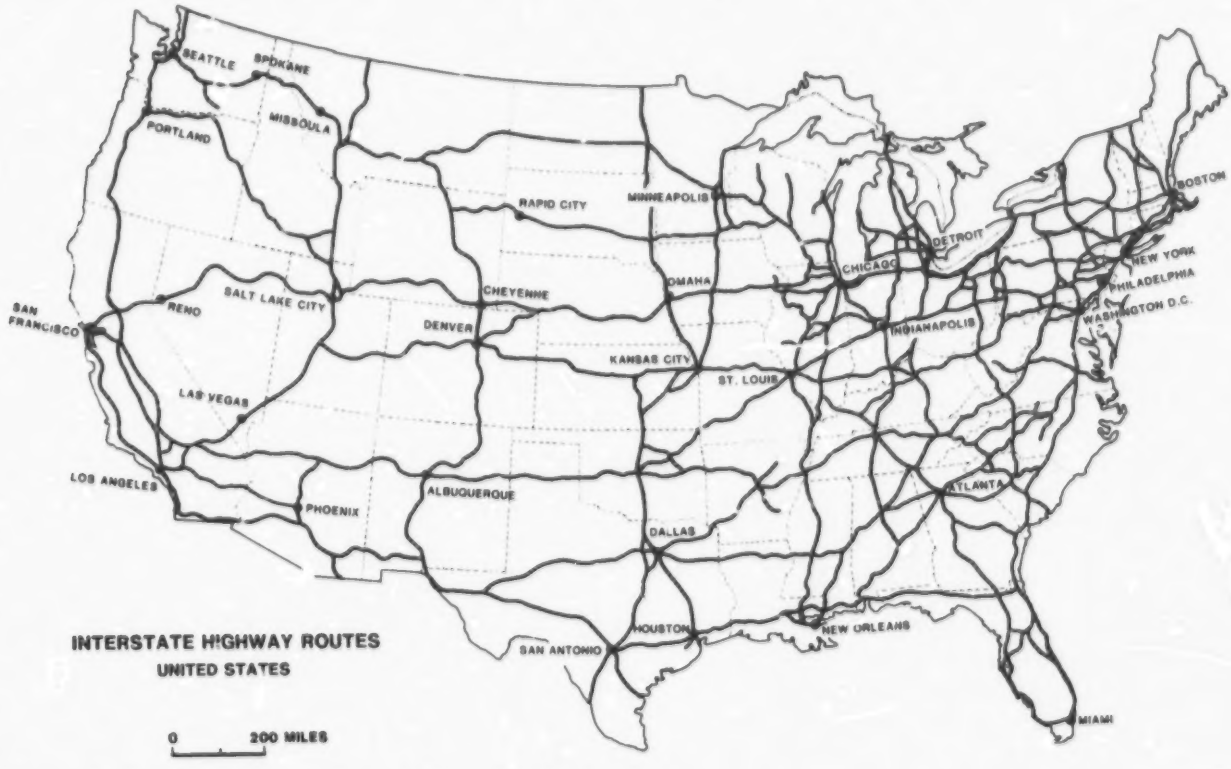

Figure 1-5—The Interstate Highway System of the continental United States

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Figure 1-6—Major rivers of the Western United States.

REFERENCES

Koch, Peter. 1987. Gross characteristics of lodgepole pine in North America. Gen. Tech. Rep. INT-227. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 311 p.

Little, Elbert L., Jr. 1971. Atlas of United States trees. Vol. 1: Conifers and important hardwoods. Misc. Publ. 1146. Washington, DC: U.S. Department of Agriculture, Forest Service. 7 p. text, 98 maps.

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CHAPTER 2: COLORADO

INTRODUCTION

In Colorado, lodgepole pine predominates on about 1.7 million acres of the State's 12.2 million acres of commercial forest land, with about 3.1 billion ft³ of lodgepole pine growing stock and 9.1 billion bd ft of sawtimber (table 2-1). Approximately 24 percent of the softwood growing stock and 18 percent of the softwood sawtimber in the State is lodgepole pine (Benson and Green 1987).

Approximately 53 percent of the dry weight of aboveground biomass of lodgepole pine trees in Colorado is in trees smaller than the 10-inch d.b.h. class (table 2-2).

The five areas selected for study by managers of public forest lands in Colorado (fig. 2-1) total 179,400 acres in gross area; they are described in the following text.

GUNNISON NATIONAL FOREST

Area Name and Location—The Taylor Lake area (figs. 2-2 and 2-3), which lies at an elevation of 10,000 to 11,500 feet at latitude 38°45' and longitude 106°30', is in the Taylor River Ranger District of the Gunnison National Forest; the Ranger Station is in Gunnison.

The gross area of about 110,000 acres includes about 75,000 acres of lodgepole pine timber type and falls entirely within Gunnison County; Gunnison is the county seat. The area is centered around Taylor Park Reservoir immediately southwest of the crest of the Sawatch Mountains (the Continental Divide), and is about 20 air miles due east from Crested Butte.

Maps of the Area—United States Geological Survey (USGS) quadrangle 7½' maps needed to depict the area are : Italian Creek, Pieplant, Taylor Park Reservoir, Fairview Peak, Tincup, Cumberland Pass, and Winfield.

Access—All-weather roads accessed from Gunnison traverse the centers of all quarters of the area. Highway mileage from Gunnison to Taylor Park Reservoir is 32 miles; this paved road is plowed during winter. Roads beyond the reservoir are not winter plowed, however. From the reservoir it is 14 miles east to Cottonwood Pass (12,126 feet) and another 22 miles to Buena Vista; this Cottonwood Pass road is scheduled to be paved. Highway distance from Cottonwood Pass to Colorado Springs is about 108 miles.

The nearest railhead is Buena Vista, on the Denver and Rio Grande Western line from Leadville through Salida to Pueblo. Salida is 25 miles south of Buena Vista. For highway distances from Salida to various market centers in the United States, see table 1-2.

Table 2-1—Volume of lodgepole pine growing stock and sawtimber, and acreage in lodgepole pine, by ownership class, Colorado[1]

Ownership class	Growing stock[2]	Sawtimber volume[3]	Commercial timberland area
	Million ft³	*Million bd ft International ¼-inch scale*	*Thousand acres*
National Forest (commercial)[4]	2,228.0	7,123.0	1,270.0
Other public	320.3	747.8	182.0
Forest industry	0	0	0
Other private	535.7	1,252.2	273.0
Total	3,084.0	9,123.0	1,725.0

[1]Source: Benson and Green (1987).
[2]**Growing stock volume** = net volume in cubic feet of live sawtimber and pole timber trees (5 inches d.b.h. and larger) from stump to a minimum 4-inch top outside bark, or to the point where the central stem breaks into limbs.
[3]**Sawtimber volume** = net volume in board feet of the sawlog portion of live sawtimber trees. Sawtimber trees are live trees of commercial species, 9 inches in d.b.h. or larger (softwood), containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect.
[4]**Commercial timberland** = forest land that is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. Areas qualifying as commercial timberland have the capability of producing in excess of 20 ft³/acre of industrial wood in natural stands.

Table 2-2—Dry weight of lodgepole pine trees, by tree component and diameter class—Colorado[1]

Diameter class	Bole[2]	Top[2]	Total
Inches	*- - - Thousand tons, ovendry basis - - -*		
2	—	1,684	1,684
4	—	4,549	4,549
6	10,274	3,854	14,128
8	8,753	2,449	11,202
10	7,571	1,940	9,511
12	6,131	1,690	7,821
14	4,232	1,064	5,296
16	2,099	502	2,601
18	1,139	255	1,394
20+	780	180	960
Total	40,979	18,157	59,146

[1]Source: Van Hooser and Chojnacky (1983).
[2]**Trees 5+ inches d.b.h.**: Bole weight = ovendry weight of wood and bark from a 1-foot stump to a 4-inch top diameter, inside bark; top weight = ovendry weight of wood and bark from a 4-inch diameter to tip of tree, plus branch material down to ¼-inch diameter.
Trees less than 5 inches d.b.h.: Total ovendry weight of wood and bark from a 1-foot stump to tip of tree, plus branch material down to ¼-inch diameter (tabulated under "Top").

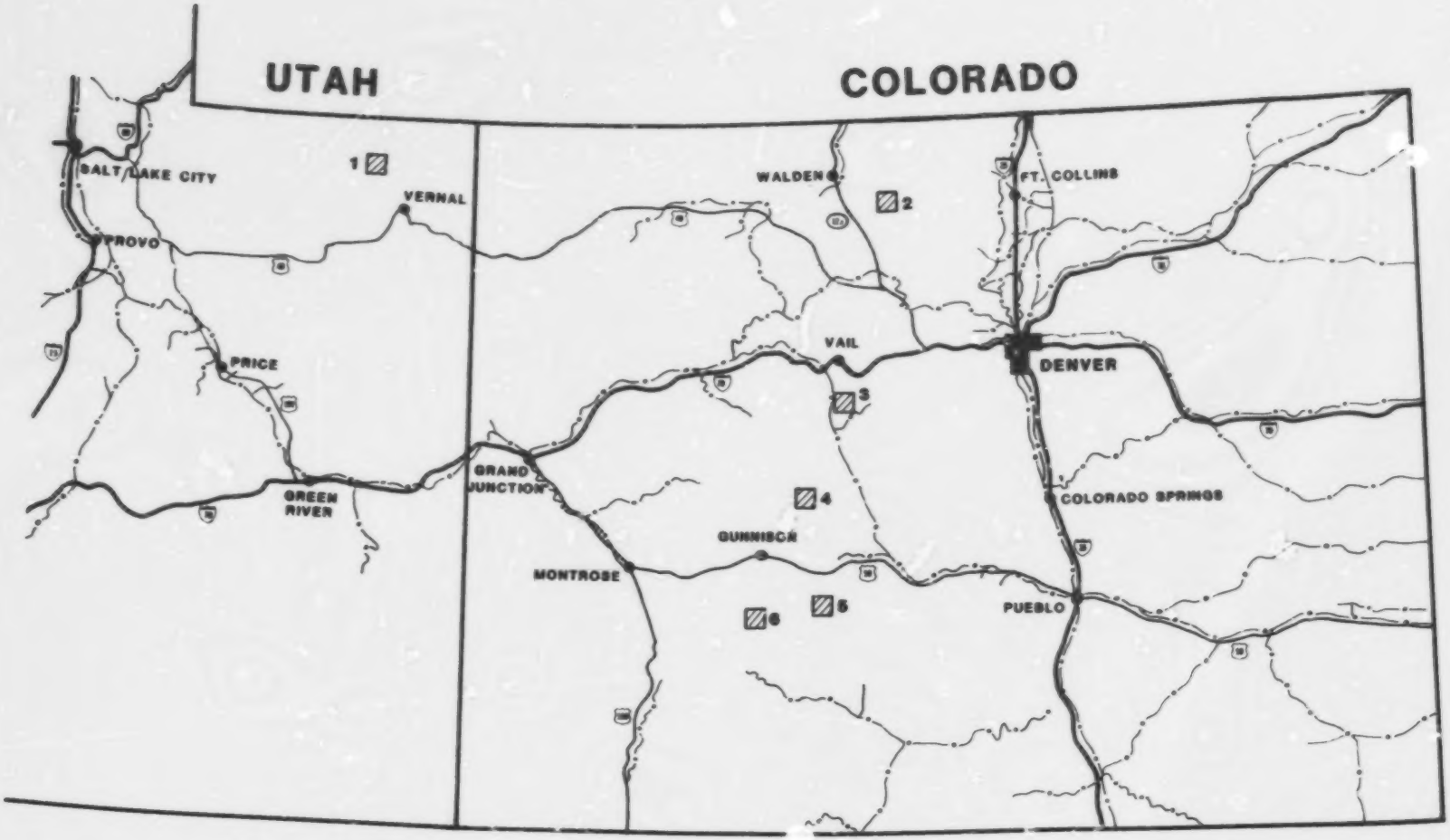

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Figure 2-1—Colorado and Utah location map. 1. Ashley NF (Alma Taylor) 16,000 acres. 2. State Forest (south end) 16,000 acres. 3. White River NF (Tennessee Pass) 28,000 acres. 4. Gunnison NF (Taylor Lake) 110,000 acres. 5. Rio Grande NF (Sheep Creek) 16,500 acres. 6. BLM Forest (Rock Creek) 8,900 acres.

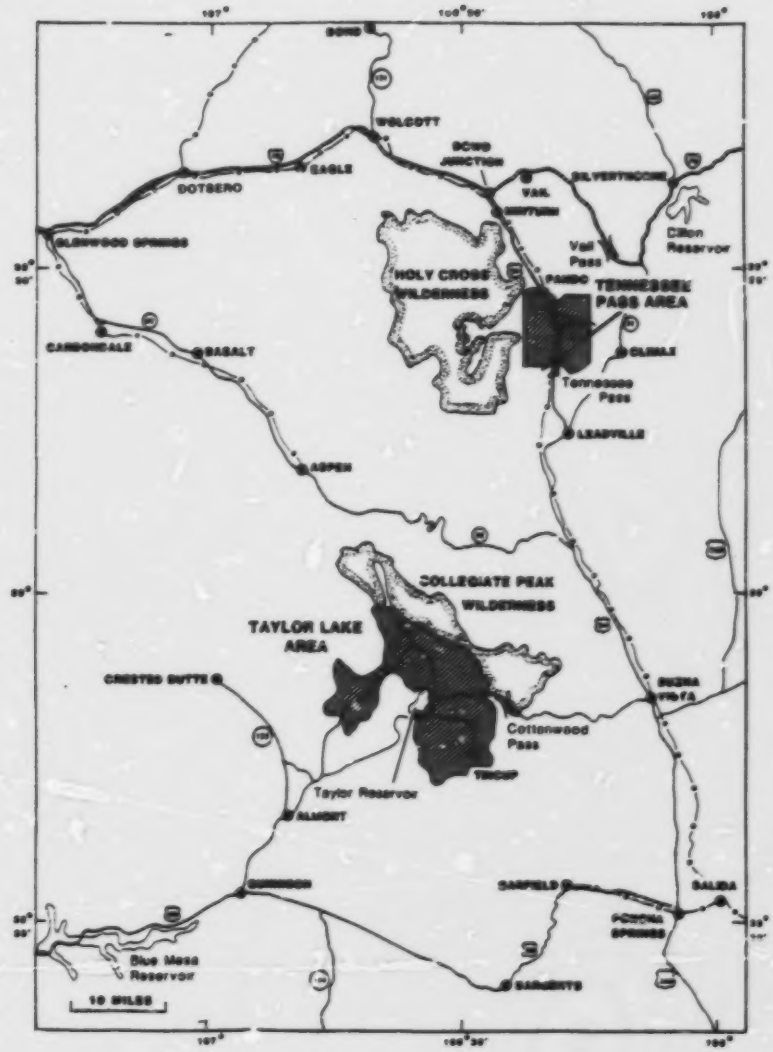

Figure 2-2—Vicinity map for the Taylor Lake (Gunnison National Forest) and Tennessee Pass (White River National Forest) areas of Colorado.

Terrain and Soil—As previously noted, the timbered area lies mostly between 10,000 and 11,500 feet elevation, with nearly three-fourths of the acreage having slopes of less than 45 percent. Soils are sandy. There are no special terrain obstacles to harvesting. Large bodies of timber are interspersed with grasslands (fig. 2-4).

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals 20 to 25 inches, with 3 feet of snow common in late winter. Snow-free season is generally from about June 1 to October 31.

General Character of the Timber—About two-thirds of the lodgepole timber acreage carries old-growth trees (200+ years); the remainder is in pole stands averaging 90 to 110 years old (figs. 2-5 and 2-6). The old-growth timber (7 to 17 inches d.b.h.) is decadent, with limby wolf trees common. Ground cover and duff are minimal. Considerable spiral grain is evident on larger down timber, particularly at higher elevations.

At present, mortality caused by mountain pine bark beetles is not evident, and there is little evidence of damage from rusts or porcupines. Dwarf mistletoe, however, is prevalent in some stands.

Harvests were extensive between 1890 and 1900. Since that time, harvest activities have been minor. Currently, however, harvesting is scheduled on a 2,000-acre sale.

Data on Sample Trees—A pair of adjacent 3½- to 4-inch trees from the tall understory of an old-growth stand (at 10,300 feet elevation and close to the Trail Creek road about 11 miles north-northwest of the reservoir) were destructively sampled. Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

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Figure 2-3—Taylor Lake area of the Gunnison National Forest. The area extends from latitude 38°42'56" in the south to 38°58'17" in the north, and from longitude 106°26'16" in the east to 106°45'33" in the west. See text for list of USGS quadrangle maps depicting the area.

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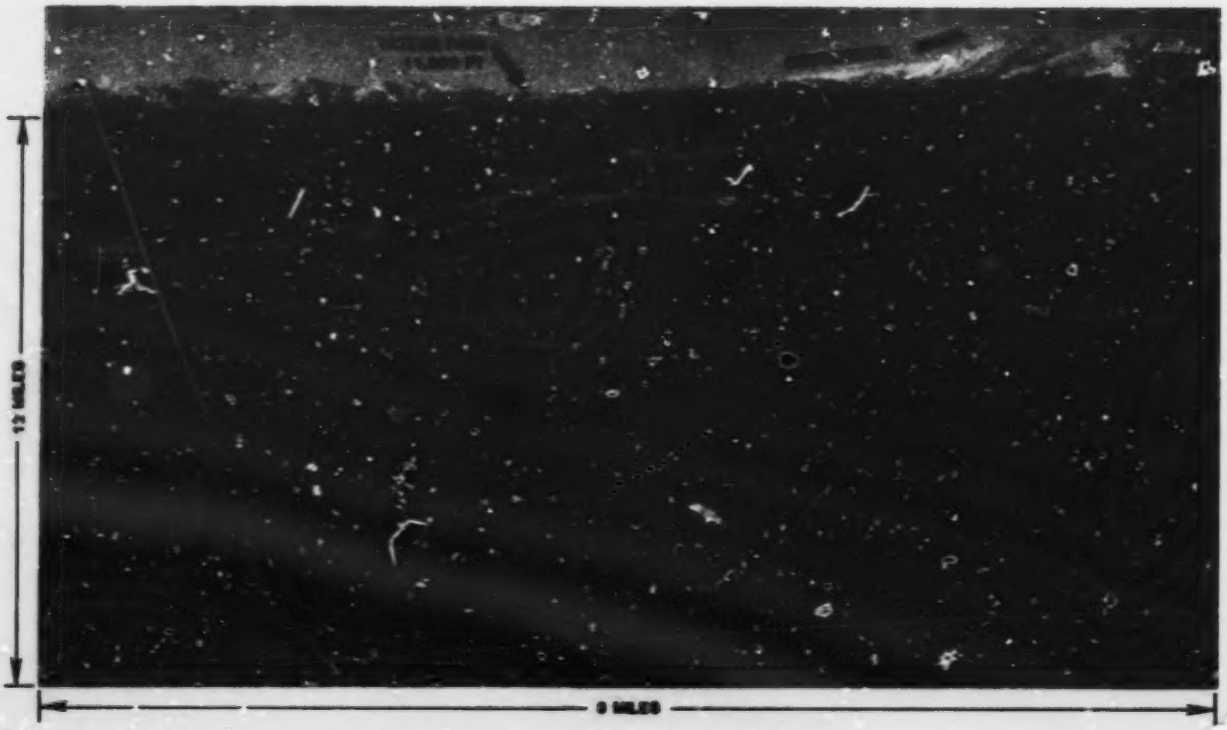

Figure 2-4—Oblique view of Taylor Lake area looking northwest from the Cottonwood Pass road; see figure 2-3 for camera viewpoint and field. Width of foreground shown is about 3 miles; from foreground to timberline on the peaks in the background is about 12 miles.

Figure 2-5—Pair of sample trees 3½ to 4 inches in d.b.h. in tall understory of old-growth stand in the Taylor Lake area of the Gunnison National Forest. See text for typical stand table.

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Figure 2-6—Pole stand in the Taylor Lake Area of the Gunnison National Forest. See text for typical stand table.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	4.05	3.57
Tree height above 6-inch high stump, feet	26.25	25.00
Crown ratio, percent	60.6	32.7
Cone serotiny	open	open
Tree age years (number of annual growth rings)		
Stump height	220	240
20 percent of tree height	200	200
Base of live crown	144	100
Diameter inside bark, inches		
Stump height	4.03	3.52
20 percent of tree height	3.54	3.18
Base of live crown	3.22	2.26
Height from stump top to base of crown, inches	123	202
Stem taper inside bark, inches/100 inches		
Below crown	0.66	0.62
Within crown	1.70	2.31
Rings/inch, average for section		
Stump height	109	136
Base of live crown	89	89
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	96.8	79.7
Specific gravity, ovendry weight and green volume	0.401	0.440
Rings/inch in first 1¼ inches radius	112	134
Maximum crushing strength, lb f/in²	5,770	6,410
Proportional limit	4,270	5,110
Modulus of elasticity, lb f/in²	950,000	1,330,000
Compression wood evident?	slight	slight
Spiral grain angle at surface, degrees	5	5
Bark thickness (single), inch	0.20	0.16
Pith eccentricity, inch	0.1	0.1

Inventory Data—Inventory data on the area are incomplete. As noted previously, about two-thirds of the lodgepole pine acreage carries old-growth timber, while one-third is in pole stands. Managers responsible for the area estimate typical stand data for these two timber age classes as follows:

D.b.h. class	Old-growth type	Pole timber type
Inches	*- - Number of live stems per acre - -*	
<2.9	48	300
3.0-3.9	100	100
4.0-4.9	120	100
5.0-5.9	159	234
6.0-6.9	159	285
7.0+	205	46
Total	791	1,065

Cubic Yield Potential and Height Growth—Although not well documented, it is estimated that the current lodgepole pine forests in the area are growing about 40 ft³ per acre per year; the potential is estimated at 60 ft³ per acre per year. Fifty-year height growth in a managed stand is undetermined, but on an above-average site in the present stands it is about 54 feet.

Management Objectives for the Area and Constraints—The primary timber management objective is harvest of the decadent older stands and replacement with thrifty, controlled-density natural regeneration. The area is much used for recreation, and it is important for its wildlife habitat and watershed functions; these values, however, are not seen as major deterrents to improved management for timber production. The major deterrent is lack of markets for stumpage. In 1985 and 1986 the forest received about $6 per thousand board feet (M bd ft) Scribner scale for lodgepole sawtimber stumpage and $5 per cord for firewood (dead trees) cut from the area. Revenues from the sawtimber stumpage were generally less than the full cost of preparing the sawtimber sales.

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Other Lodgepole Pine Available in the Area From Public Lands—In addition to the 75,000 acres of lodgepole pine in the Taylor Lake area, the Cebolla Ranger District of the Gunnison National Forest—immediately south of the Taylor River Ranger District—has an additional 140,000 acres of lodgepole pine timber type. About 70,000 of these acres are similar to those in the Taylor Lake area.

Forest Products Industry in the Vicinity—There are no large forest industries immediately adjacent to the area. Major timber consumers in the region include a large sawmill cutting random-length dimension lumber and a structural flakeboard plant—both near Montrose, CO. Also, a house log manufacturer operates in Poncha Springs.

Population in the Vicinity—Gunnison County has a total population of 11,286 (1983), almost all of whom reside within 30 miles of Gunnison—the home of Western State College. Population within the limits of the town of Gunnison totals 5,902. In 1983 the per-capita income in Gunnison County was $7,874, with 5.9 percent of the workforce unemployed.

Chaffee County, with a population of 13,500, contains the nearest railhead at Buena Vista (population 2,500). The county seat of Chaffee County is Salida (population 5,000). In 1984, 12.1 percent of the county workforce was unemployed.

RIO GRANDE NATIONAL FOREST

Area Name and Location—The Sheep Creek area (figs. 2-7 and 2-8), which lies at an elevation of 9,000 to 11,500 feet at latitude 38°15' and longitude 106°30', is in the Saguache Ranger District of the Rio Grande National Forest; the Ranger Station is in Saguache.

The gross area of about 16,500 acres includes about 9,100 acres of lodgepole pine timber type and falls entirely within Saguache County; Saguache is the county seat. The area is centered around the upper end of Sheep Creek and lies immediately south of the Continental Divide; it is about 23 air miles northwest from Saguache on a heading of 303°.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: West Baldy, Sargents Mesa, North Pass, and Trickle Mountain.

Access—From a point 25.5 miles west of Saguache on paved State Highway No. 114, an unimproved dirt road

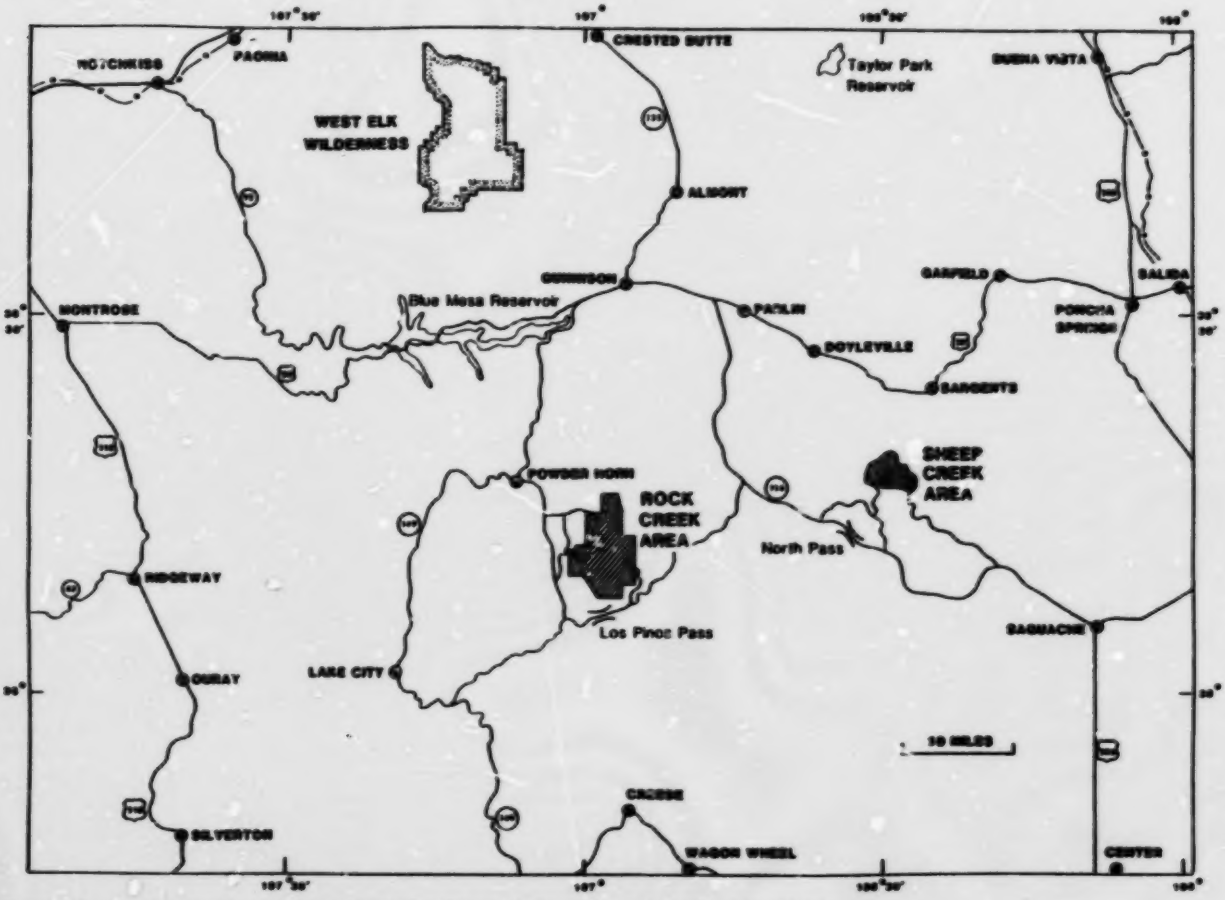

Figure 2-7—Vicinity map for the Sheep Creek (Rio Grande National Forest) and Rock Creek (Bureau of Land Management) areas of Colorado.

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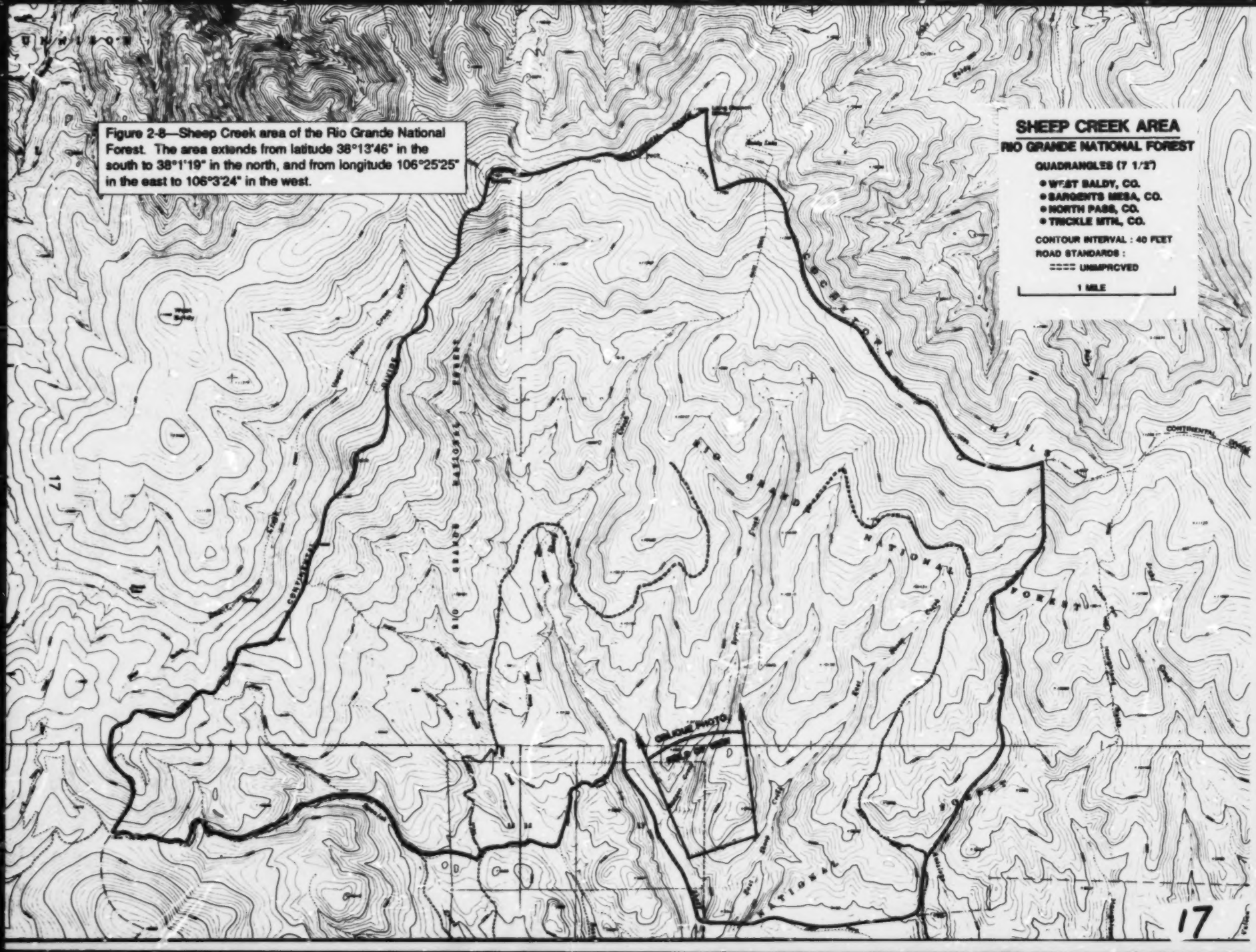

Figure 2-8—Sheep Creek area of the Rio Grande National Forest. The area extends from latitude 38°13'46" in the south to 38°1'19" in the north, and from longitude 106°25'25" in the east to 106°3'24" in the west.

(FDR No. 810) leads north 10.3 miles through the center of the western portion of the area to a road end in the center of the area. Another unimproved dirt road (FDR No. 850) leading from State Highway No. 114 gives access to the eastern part of the area.

The nearest railhead is Salida on the Denver and Rio Grande Western line from Leadville to Pueblo. For highway distances from Salida to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 9,000 and 11,500 feet elevation (figs. 2-9 and 2-10), with about three-quarters of the acreage having slopes less than 45 percent. Soils are of volcanic origin and are highly erosive. There are no special obstacles to harvesting.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals about 20 inches, with 2 feet of snow commonly on the ground during winter. The snow-free season generally extends from mid-May to early November.

General Character of the Timber—The lodgepole timber in the area can be classified into three types. The predominant type (about 37 percent of the acreage) typically has 1,000 to 2,000 stems per acre of suppressed trees about 25 feet in height and measuring 1½ to 6 inches in d.b.h., with most trees 3 to 4 inches in d.b.h. and 90 to 120 years old. Crown ratios are typically 30 percent (fig. 2-11).

Pole stands with 400 to 600 trees per acre, 4 to 7 inches in d.b.h., 30 to 32 feet high, occupy about 35 percent of the area. These trees are also 90 to 120 years old. Older stands (200+ years) have only about 100 trees per acre, but measure 7 to 12 inches in d.b.h., and are 40 to 50 feet high, with crown ratio of about 40 percent.

In most stands, approximately half the trees bear open cones, and half bear closed cones. Thirty to 60 percent of seeds from the cones are viable.

At present (1986), no damage from mountain pine beetle is evident, but western gall rust has caused cankers in a significant proportion of the trees. There is little to no damage from dwarf mistletoe, and porcupine damage is not evident.

There has been virtually no harvesting activity in the area in the past. In the older stands, some minor harvests are planned.

Data on Sample Trees—To provide more than casual observational data descriptive of the trees, a pair of adjacent 3½- to 4-inch codominant trees were destructively sampled. The trees were located on fairly level terrain at 10,200 feet elevation (fig. 2-11) about one-quarter mile south of the road end in the central part of the area. Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluating of mechanical properties parallel to the grain at 10 percent moisture content.

Figure 2-9—Oblique view of the Sheep Creek area looking north-northwest from a promontory on lower Sheep Creek; see figure 2-8 for field of view. From the foreground to the Continental Divide, which forms the skyline, it is about 5½ miles. Length of ridge shown on the skyline is about 2½ miles.

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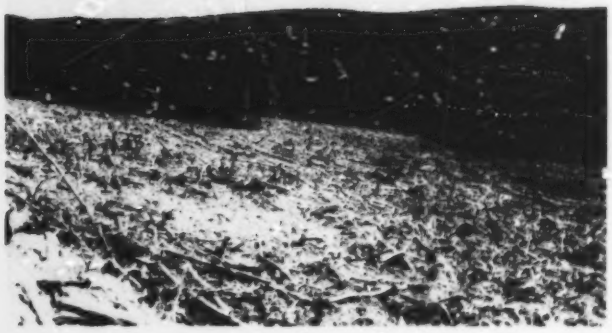

Figure 2-10—View looking east across Spruce Creek in the central part of the Sheep Creek area of the Rio Grande National Forest. In an effort to replace a stagnated stand, the area in foreground was trampled and roller chopped without previous harvest or subsequent burn; regeneration, while not evident in the photo, is present. In the background, trees are 200+ years old—except for the old-burn area visible in the right background, which now supports a younger pole stand.

Figure 2-11—Pair of codominant sample trees 3½ to 4 inches in d.b.h. in a stagnated stand at about 10,200 feet elevation in the Sheep Creek area of the Rio Grande National Forest.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.90	3.5
Tree height above 6-inch high stump, feet	21.8	22.0
Crown ratio, percent	35.6	37.1
Cone serotiny	closed	closed
Tree age years (number of annual growth rings)		
Stump height	130	130
20 percent of tree height	110	105
Base of live crown	71	60
Diameter inside bark, inches		
Stump height	3.82	3.61
20 percent of tree height	3.65	3.33
Base of live crown	2.75	2.37
Height from stump top to base of live crown, inches	168	166
Stem taper inside bark, inches/100 inches		
Below crown	0.64	0.75
Within crown	2.96	2.42
Rings/inch, average for section		
Stump height	68	72
Base of live crown	52	51
Properties of stem wood at 20 percent height		
Moisture content, percent ovendry weight	75.5	65.0
Specific gravity, ovendry weight and green volume	0.438	0.384
Rings/inch in first 1¼ inches radius	48	36
Ultimate compressive strength, lb f/in²	5,790	5,250
Proportional limit, lb f/in²	3,610	4,140
Modulus of elasticity, lb f/in²	970,000	870,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	7	3
Bark thickness (single), inch	0.15	0.16
Pith eccentricity, inch	0.6	0.4

Inventory Data—Inventory data are incomplete. See prior comments under paragraph heading "General Character of the Timber" for stand-table generalizations about the three types of lodgepole pine timber present.

Cubic Yield Potential and Height Growth—Although data are not well documented, managers responsible for the area estimate that the current stands are growing more than 10 ft³ per acre per year. Under management they might grow 25 ft³ per acre per year. Fifty-year height growth in managed stands is estimated at 30 to 35 feet.

Management Objectives for the Area and Constraints—The primary timber management objective is phased harvest of the stagnant and decadent stands and replacement with thrifty, controlled-density natural regeneration. The area has significant value for watershed, wildlife habitat, and recreation—values that could be enhanced and protected by appropriate management for timber production.

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The major deterrent is lack of markets for stumpage. In 1985 and 1986 the forest received $2 to $20 (mostly $2) per M bd ft Scribner scale for lodgepole pine sawtimber stumpage, $5 per cord for dead-timber firewood, and $12.50 per cord for live-timber firewood and miscellaneous roundwood from the area. Revenues from sawtimber stumpage for the area were generally less than the full cost of preparing the sawtimber sales.

Other Lodgepole Pine Available in the Area—In addition to the lodgepole pine on the Sheep Creek area, the Saguache Ranger District has approximately 20,000 acres of the same kind of lodgepole timber. And, as noted in discussions of the Taylor Lake area, the Cebolla Ranger District of the Gunnison National Forest to the north and west has perhaps 75,000 acres of similar lodgepole pine.

Forest Products Industry in the Vicinity—There are three very small sawmills in Saguache. Monte Vista has a medium-size sawmill; Alamosa has a moderately large mill—but it was not in operation at 1986 yearend; and South Fork has a large stud mill and a medium-size sawmill for random-length dimension lumber. A small industry producing mine props and house logs operates in Creede.

Population in the Vicinity—Saguache County has a total population of 3,946 (1985); population within the limits of the town of Saguache totals 625. In 1980 the per-capita income in Saguache County was $4,504, with 16 percent of the workforce unemployed in 1985.

Chaffee County, with a population of 13,500, contains the nearest railhead at Salida (population 5,000). In 1984, 12.1 percent of the county workforce was unemployed.

WHITE RIVER NATIONAL FOREST

Area Name and Location—The Tennessee Pass area (figs. 2-2, 2-12, and 2-13), which lies at an elevation of 10,000 to 11,000 feet at latitude 39°26' and longitude 106°25', is in the Holy Cross Ranger District of the White River National Forest; the Ranger Station is in Minturn.

The gross area of about 28,000 acres includes about 11,000 acres of lodgepole pine timber type and falls entirely within Eagle County; Eagle is the county seat. The Lake County northern line (the Continental Divide) is the southern border of the area; the county seat of Lake County is Leadville. The area is centered around Eagle Park and the Camp Hale recreation area.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Pando and Leadville North.

Access—U.S. Highway No. 24 connects with Interstate 70 near Vail and runs south through the center of the area, over Tennessee Pass (10,424 feet) to Leadville and Buena Vista. A Denver and Rio Grande Western rail line parallels this road (fig. 2-2). The Wurts Ditch Road (unimproved dirt) traverses the western portion of the area, and several improved and unimproved roads penetrate the eastern portion (fig. 2-12). From Minturn south to Tennessee Pass is 20 miles; Leadville is about 10 miles south of Tennessee Pass.

For highway distances from Leadville to various market centers in the United States, see table 1-2

Terrain and Soil—As previously noted, the timbered area lies mostly between 10,000 and 11,000 feet elevation, with nearly half the lodgepole pine acreage on slopes of less than 45 percent (fig. 2-14). Soils are decomposed granite, with no volcanic ash deposition. The terrain is not excessively stony. Ground cover is light and duff is thin.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation is about 30 inches, most falling as snow, with heavy snow accumulation in winter months. The snow-free season generally extends from June 1 to the end of October.

General Character of the Timber—At upper elevations, stands tend to be somewhat open and trees limby (fig. 2-15), with all-age stands common. On the main benches at midelevation, pole stands are more typical of the species (fig. 2-16). Stands vary in age from about 85 to 135 years.

At present, mortality caused by mountain pine beetle is not evident. Most stands have light infestations of dwarf mistletoe, but not all. Cankers caused by rust infections are not common, and significant porcupine damage is not evident.

The area was extensively harvested and/or burned in 1890-1900. Except for small-scale firewood and post-and-pole cutting, harvesting activity is minimal at present. No major harvesting activity has been planned because the area is distant from mills.

Data on Sample Trees—A pair of adjacent 3½- to 4-inch codominant trees were destructively sampled from a south slope about three-fourths mile east of Camp Hale site (fig. 2-16). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

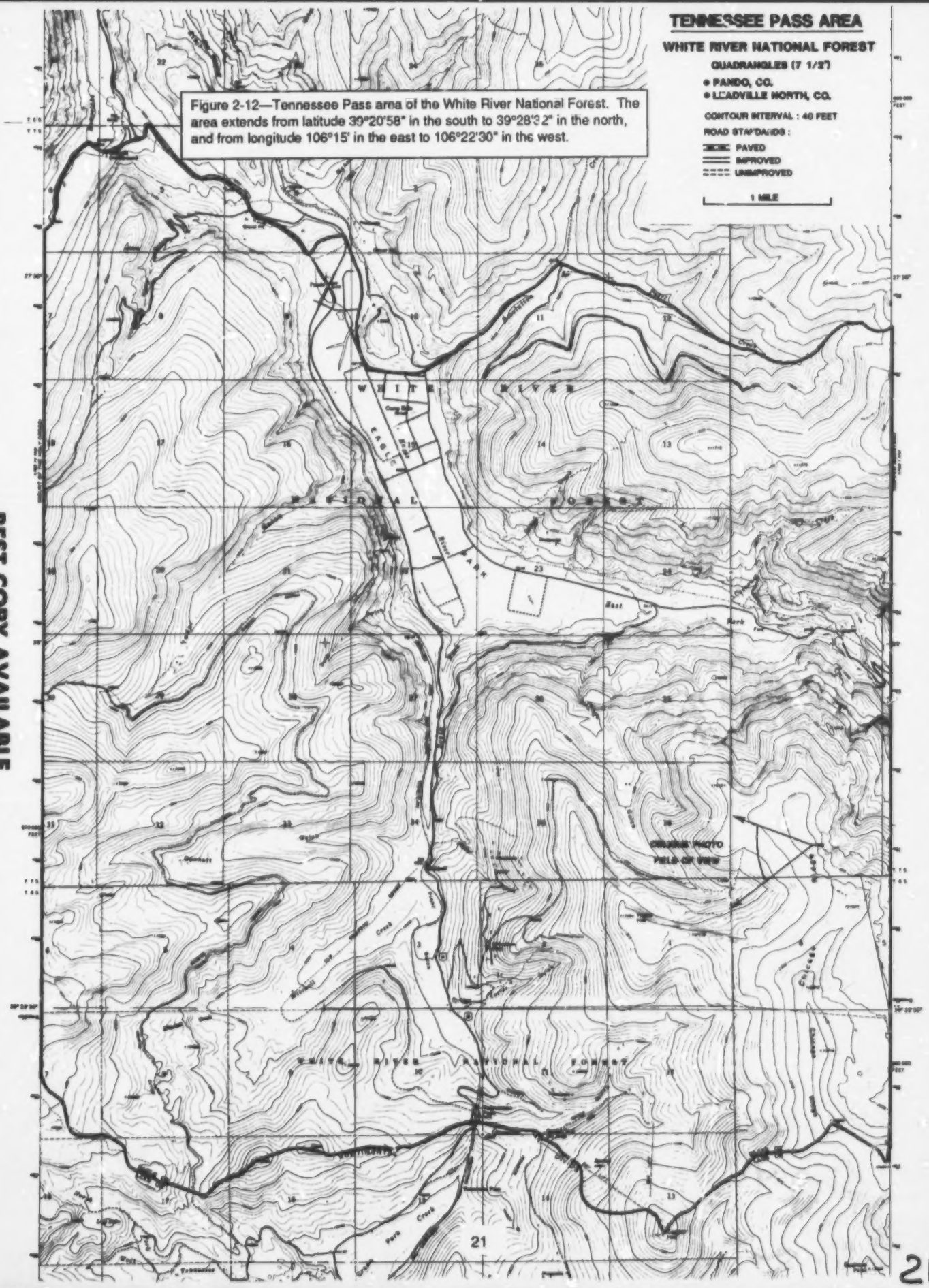

Figure 2-12—Tennessee Pass area of the White River National Forest. The area extends from latitude 39°20'58" in the south to 39°28'32" in the north, and from longitude 106°15' in the east to 106°22'30" in the west.

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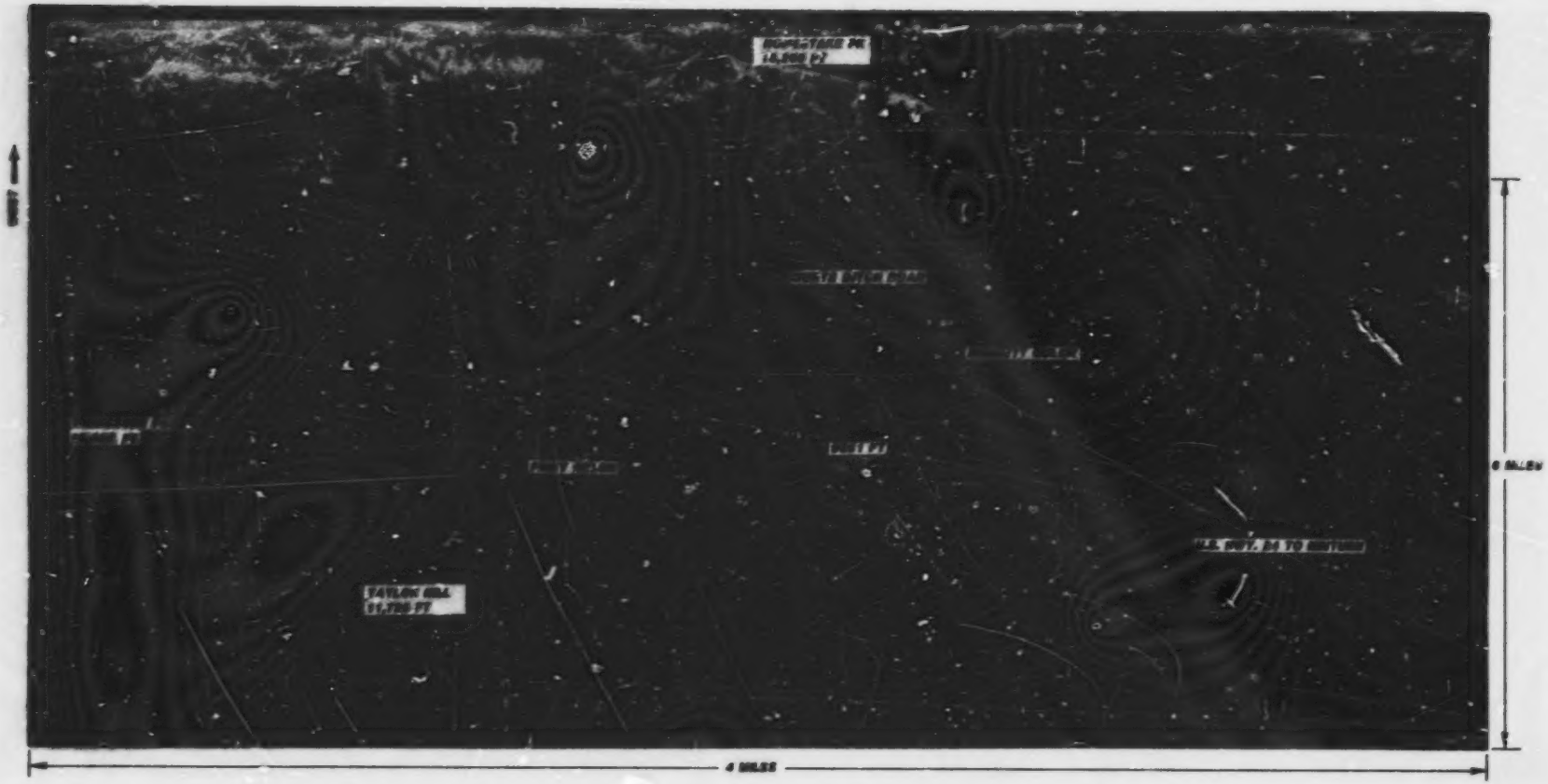

Figure 2-13—Oblique aerial view of the Tennessee Pass area of the Whi[illegible]ver National Forest looking east (see fig. 2-12 for camera viewpoint and field of view). Width of foreground shown is about 4 miles; from foregroun[illegible]treeline in the center background is about 6 miles.

Figure 2-14—View northwest across U.S. Highway No. 24 and the Denver and Rio Grande Western rail line paralleling it from Minturn to Leadville and Buena Vista. Terrain below Wurts Ditch visible in ' ackground.

Figure 2-15—In the Tennessee Pass area of the White River National Forest these trees 6 to 12 inches in diameter, in a somewhat open stand, tended to retain limbs.

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Figure 2-16—Pair of codominant sample trees 3½ to 4 inches in d.b.h. in pole stand at about 10,000 feet near the prominent switchback on the Pearl Creek Road just east of Camp Hale in the Tennessee Pass area of the White River National Forest. Such trees are typical of lodgepole pine found on the medium-elevation forested benches of the area.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.80	3.70
Tree height above 6-inch high stump, feet	38.7	39.3
Crown ratio, percent	24	38
Cone serotiny	no cones	closed
Tree age years (number of annual growth rings)		
Stump height	132	130
20 percent of tree height	112	120
Base of live crown	52	70
Diameter inside bark, inches		
Stump height	3.90	3.66
20 percent of tree height	3.29	3.28
Base of live crown	1.89	2.32
Height from stump top to base of crown, inches	351	292
Stem taper inside bark, inches/100 inches		
Below crown	0.57	0.46
Within crown	1.67	1.29
Rings/inch, average for section		
Stump height	68	71
Base of live crown	55	60
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	80.6	73.2
Specific gravity, ovendry weight and green volume	0.421	0.427
Rings/inch in first 1¼ inches radius	40	48
Maximum crushing strength, lb f/in²	5,660	6,270
Proportional limit, lb f/in²	3,830	4,640
Modulus of elasticity, lb f/in²	1,150,000	1,150,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	0	8
Bark thickness (single), inch	0.11	0.09
Pith eccentricity, inch	0.2	0.2

Inventory Data—The entire area has been timber-type mapped, but inventory data are incomplete. Like most other lodgepole pine forests, the timber varies in a continuum from one type to another. At the risk of oversimplification, managers responsible for the area suggest the following generalized stand-table data as representative of pole stands on benches (fig. 2-16), and more open stands of larger trees (fig. 2-15); probably the larger timber type predominates, with tree heights of 50 to 60 feet:

D.b.h. class	Pole timber type	Larger-timber type
Inches	*Number of live lodgepole stems per acre*	
<2.9	100 (cull)	200 (cull)
3.0-4.9	125	0
5.0-6.9	120	20
7.0-8.9	40	95
9.0-10.9	25	65
11.0+	15	25
Total	425	405

Cubic Yield Potential and Height Growth—Site productivity estimated on 114 lodgepole pine plots in the area averaged 32 ft³ of stemwood per acre per year, with most in the range from 22 to 42 ft³. Fifty-year height growth in managed stands is estimated to be 35 to 40 feet.

Management Objectives for the Area and Constraints—Diversity of age classes in the lodgepole pine stands is desired. Species diversity (to include spruce and alpine fir) is also desired.

While it is important to maintain visual esthetic values, and to improve wildlife habitat and watershed quality, these values are not seen as significantly constraining harvest. Lack of markets for stumpage is the primary constraint to management. In 1985 and 1986 the National Forest received about $6 per M bd ft Scribner scale for lodgepole pine sawtimber stumpage and $5 per cord for firewood (dead timber only) from the area. Revenues from sawtimber stumpage were generally less than the full cost of preparing sawtimber sales in the area.

Other Lodgepole Pine Available in the Area From Public Lands—In addition to the approximately 11,000 acres of lodgepole pine in the Tennessee Pass area of the

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Holy Cross Ranger District, the Leadville Ranger District immediately south of Tennessee Pass has as much or more acreage of lodgepole pine.

Forest Products Industry in the Vicinity—There are no major wood-consuming industries in the immediate vicinity of the Tennessee Pass area. The nearest operation utilizing large tonnages of lodgepole pine is a structural flakeboard plant 90 miles to the north in Kremmling, CO.

Population in the Vicinity—Lake County has a total population of 9,980 (1981). Population within the limits of the town of Leadville totals 5,024 (1985). During 1985, unemployment rate for Lake County averaged 13.2 percent. Annual per-capita income in Lake County in 1984 was $8,612.

Eagle County had a population of 13,171 in 1980, and the town of Minturn had a population of 1,060. In 1984, annual per-capita income in Eagle County was $14,161. During 1985 the unemployment rate averaged 5.5 percent in the county.

STATE FOREST

Area Name and Location—The south end area (figs. 2-17, 2-18, and 2-19) of the Colorado State Forest lies from 9,000 to 10,000 feet at latitude 40°34' and longitude 105°58'. It is administered from the headquarters office just east of Gould.

While the area delineated in figure 2-18 is only about 6,000 acres, there is in the vicinity a total of about 16,000 contiguous acres of similar State Forest land. Of this 16,000 acres, about 70 percent is in meadows, aspen, and spruce—leaving about 30 percent or 4,800 acres in lodgepole pine type. The area is centered northwest of the Bockman Lumber Camp site (now out of operation), about 45 air miles due west of Fort Collins and 22 air miles

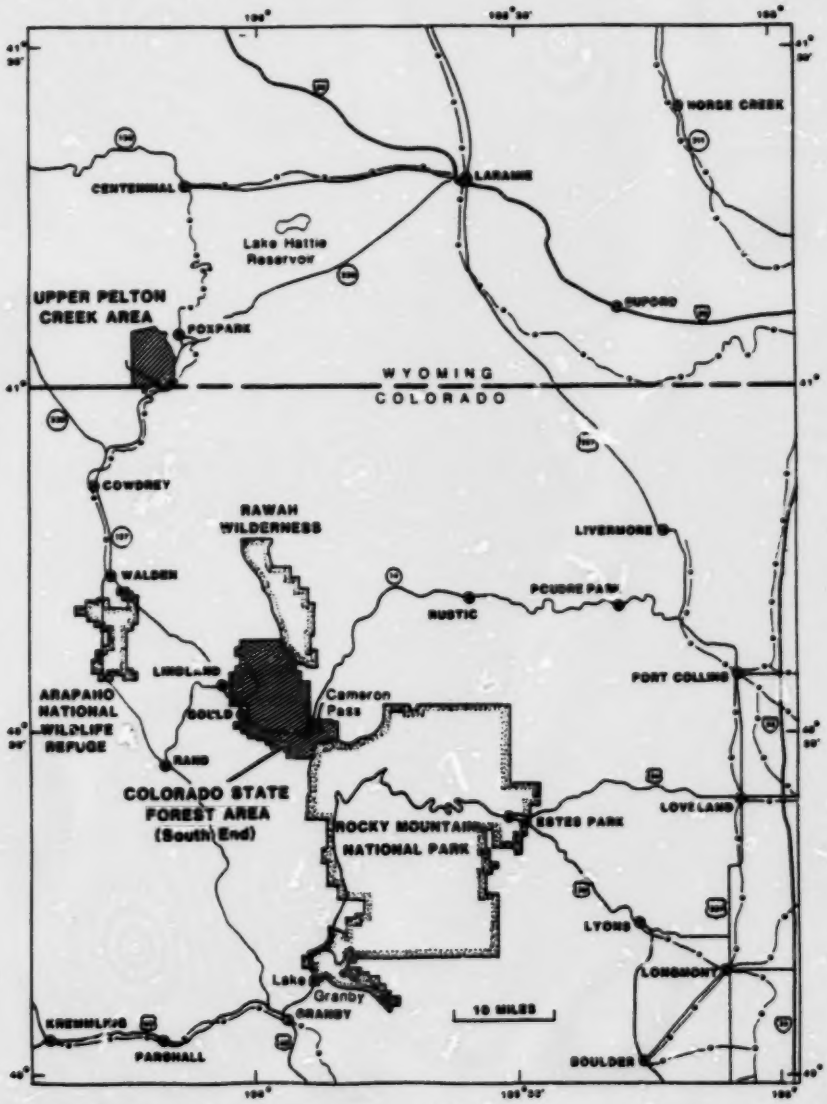

Figure 2-17—Vicinity map for the south end area of the Colorado State Forest and the Upper Pelton Creek area of the Medicine Bow National Forest in Wyoming.

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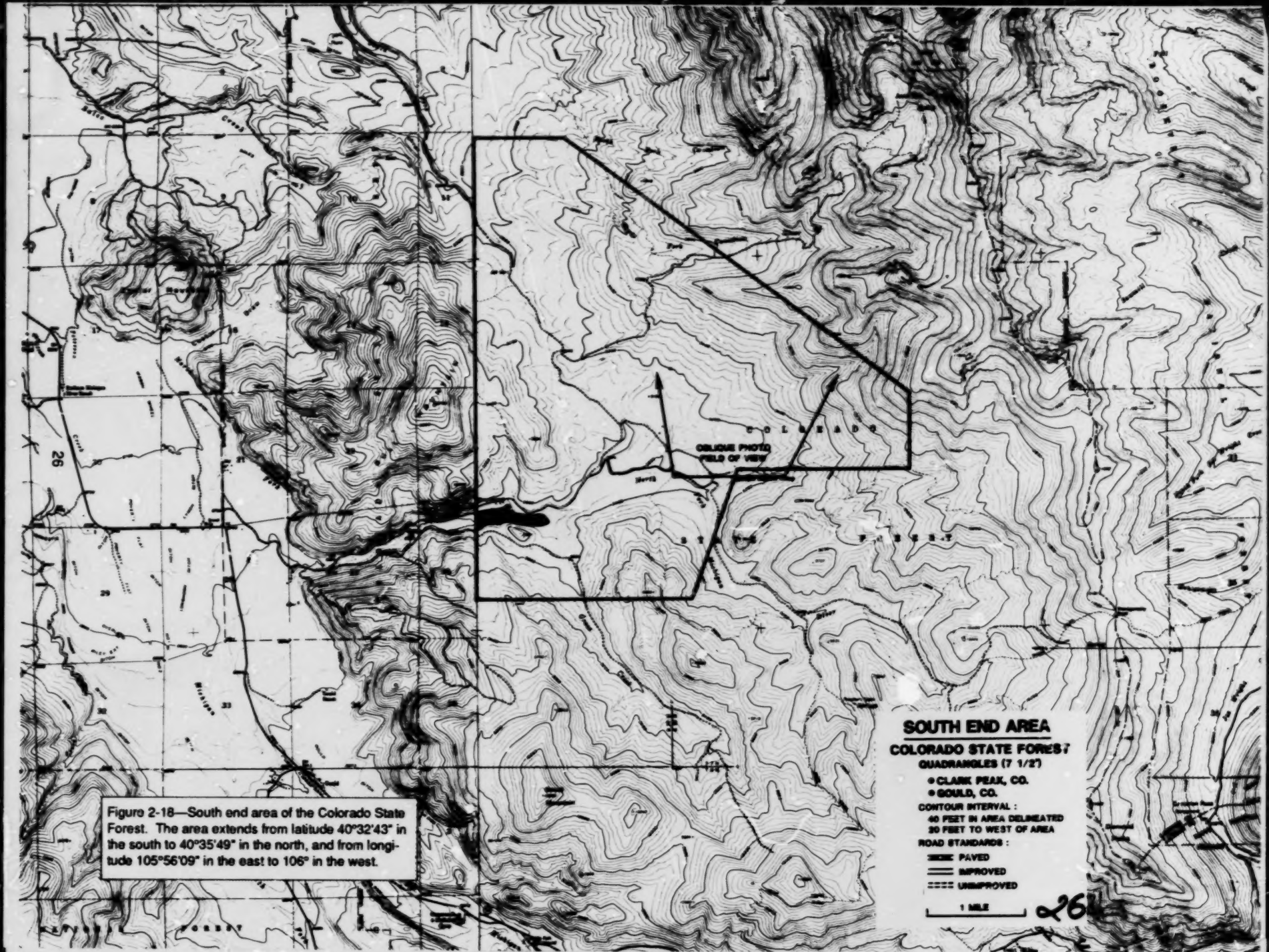

Figure 2-18—South end area of the Colorado State Forest. The area extends from latitude 40°32'43" in the south to 40°35'49" in the north, and from longitude 105°56'09" in the east to 106° in the west.

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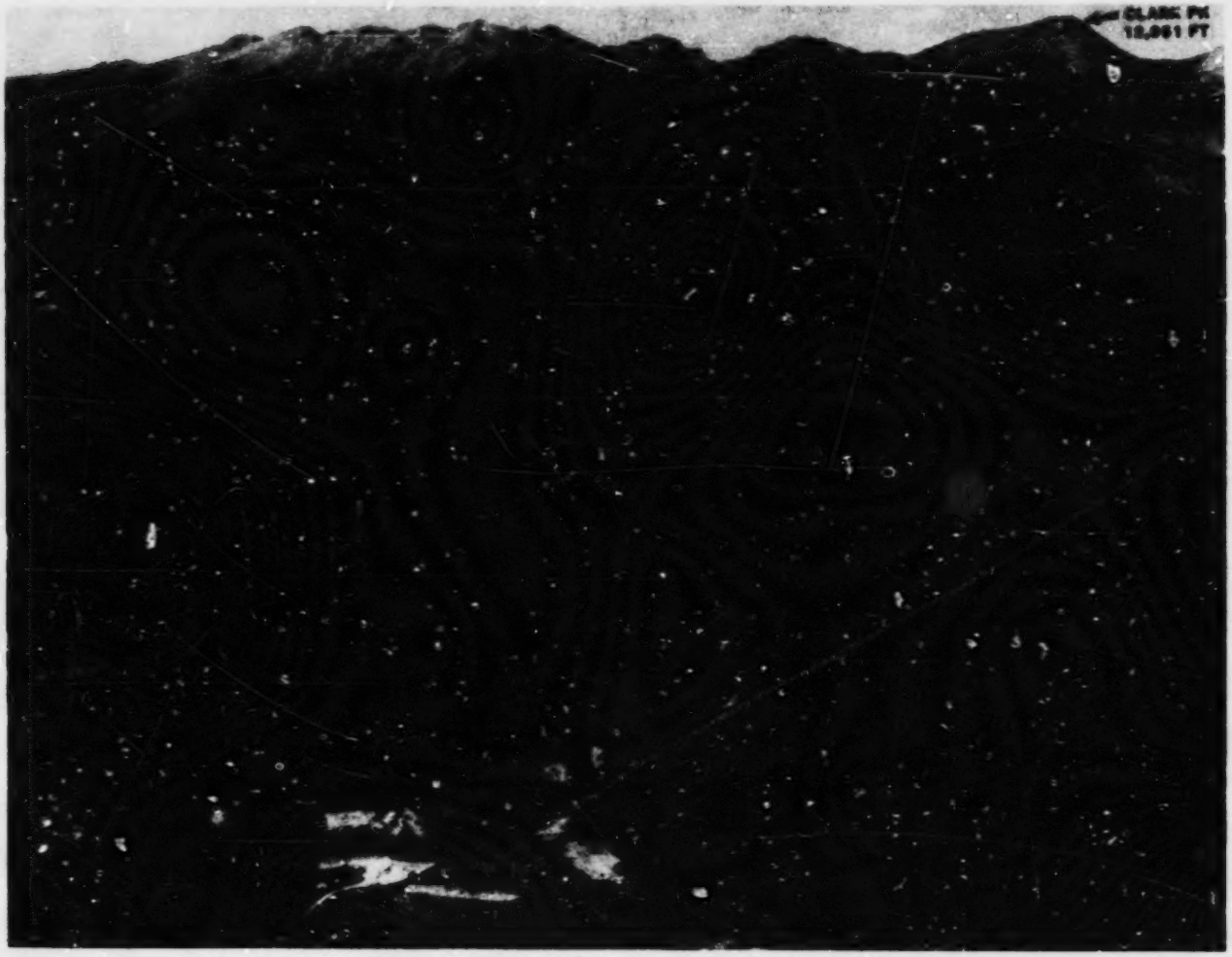

Figure 2-19—View in the south end of the Colorado State Forest from just south of Bockman Lumber Camp looking north-northwest toward the crest of the Medicine Bow Mountains. From Bockman Lumber Camp to Clark Peak is 3.8 miles.

southeast of Walden on a heading of 128°. The crest of the Medicine Bow Mountains is immediately east of the area.

The area is in Jackson County. Walden is the county seat.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Clark Peak and Gould.

Access—Access to the area is from State Highway No. 14 a couple of miles north of Gould, via a secondary improved road into Michigan Reservoir on the North Fork of the Michigan River. Road distance from State Forest headquarters near Gould to Bockman Lumber Camp site is about 10 miles. From Bockman Lumber Camp site, unimproved roads run into both northeastern and northwestern parts of the area (fig. 2-18).

Walden (elevation 8,300 feet), about 26 road miles from the Bockman site, is the nearest railhead. A more distant railhead is Granby, 57 road miles south via Rand. The railhead at Fort Collins is 92 road miles distant via 10,285-foot Cameron Pass.

For highway distances from Fort Collins to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the timbered area lies mostly between 9,000 and 10,000 feet, with about three-quarters of the lodgepole pine timber on slopes less than 45 percent. Soils, derived from glacial tills and weathered basalt flows, are deep and well drained.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals about 25 inches, with 3 to 4 feet of snow on the ground common in winter. Snow-free season is generally mid-June through mid-September.

General Character of the Timber—About 20 percent of the 4,800 acres of lodgepole pine forest type in the area is in uneven-aged stands residual from logging activities prior to 1960; these stands (fig. 2-20), mostly located within the area delineated in figure 2-18, are heavily infested with dwarf mistletoe.

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Figure 2-20—Uneven-aged, mistletoe-infested, high-graded forest residual from prior-to-1960 logging activities on the south end area of the Colorado State Forest. This forest type is representative of about 20 percent of the lodgepole pine type forest in the south end area.

Figure 2-21—Even-aged pole stand 100+ years old representative of about 80 percent of the lodgepole pine type acreage on the south end of the Colorado State Forest. These trees are mostly 3 to 7 inches in d.b.h, with some as large as 10 to 11 inches; few would exceed 50 feet in height.

The remaining 80 percent of the 4,800 acres of lodgepole pine carries 100+-year-old pole stands, with trees mostly 3 to 7 inches in d.b.h.—but with some trees as large as 10 to 11 inches (fig. 2-21).

Clumps and stringers of aspen are common throughout the lodgepole-type forest.

At present, mortality from mountain pine beetle attacks is not evident, and there is little porcupine damage. Comandra rust has caused cankers in some trees and dwarf mistletoe is plentiful—particularly in the stands high-graded by loggers.

Loggers were most active in the area during the 1930's, and significant harvesting continued until 1960. Currently, only posts and poles for local use are harvested. The area has few trees large enough to interest sawmillers.

Data on Sample Trees—To provide more than casual observational data descriptive of the trees, a pair of adjacent 3½- to 4-inch codominant trees were destructively sampled at 9,100 feet from near-level terrain about 3 miles northwest of Bockman Lumber Camp site. Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representive of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.40	3.92
Tree height above 6-inch high stump, feet	39.5	43.0
Crown ratio, percent	35.7	55.8
Cone serotiny	closed	closed
Tree age years (number of annual growth rings)		
Stump height	100	101
20 percent of tree height	78	80
Base of live crown	53	66
Diameter inside bark, inches		
Stump height	3.60	4.12
20 percent of tree height	3.00	3.40
Base of live crown	1.95	2.82
Height from stump top to base of crown, inches	305	228
Stem taper inside bark, inches/100 inches		
Below crown	0.54	0.62
Within crown	1.15	0.98
Rings/inch, average for section		
Stump height	56	49
Base of live crown	38	47
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	72.7	80.2
Specific gravity, ovendry weight and green volume	0.424	0.404
Rings/inch in first 1¼ inches radius	38	30
Maximum crushing strength, lb f/in²	6,330	5,160
Proportional limit, lb f/in²	5,500	4,540
Modulus of elasticity, lb f/in²	1,470,000	1,030,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	7	3
Bark thickness (single), inch	0.10	0.10
Pith eccentricity, inch	none	0.2

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Inventory Data—Inventory fieldwork for the area was initiated in 1986, but data were not available in time for inclusion in this report. As noted previously, about 80 percent of the lodgepole pine acreage is in 100+-year-old pole stands. Managers responsible for the area estimate typical stand data for these acres as follows (tree height averages about 50 feet):

D.b.h. class	Pole timber type
Inches	*Number of live stems per acre*
<2.9	300
3.0-3.9	290
4.0-4.9	295
5.0-5.9	100
6.0-6.9	200
7.0-7.9	150
8.0+	80
Total	1,415

Cubic Yield Potential and Height Growth—Although data are not well documented, area managers estimate that current growth is about 19 ft^3 of stemwood per acre per year; for managed stands it should be about 25 ft^3 per acre per year. Fifty-year height growth in managed stands is estimated to be about 35 feet.

Management Objectives for the Area and Constraints—Objectives include: improvement of general stand health and vigor, enhancement of wildlife habitat, contributions to all recreation uses occurring on the State Forest, maintenance of water quality and quantity, enhancement of esthetic values, sustained production of wood, enhancement of domestic-animal grazing, and enhancement of forestry education potential.

The primary obstacle to forestry practices for accomplishment of the objectives is lack of markets for small-diameter lodgepole pine. At considerable risk of oversimplification, following are approximate lodgepole pine stumpage prices obtained by the State in 1985 and 1986 from this area: sawtimber, $6 to $16 per M bd ft Scribner scale; dead timber for firewood, $5 per cord; Christmas trees, $5 per tree. Revenues from timber sales (as well as those from grazing, recreation, fishing, and hunting) help fund the school system of the State.

Other Lodgepole Pine Available in the Area From Public Lands—Additional lodgepole pine acreage administered by the Routt National Forest and by the Bureau of Land Management lies to the south of the Colorado State Forest, but the extent and availability of this acreage was not investigated.

Forest Products Industry in the Vicinity—A major sawmill producing random-length dimension lumber operates in Walden, and structural flakeboard utilizing lodgepole pine is manufactured in Kremmling—about 80 road miles southwest of Bockman Lumber Camp site. In Fort Collins there are plants manufacturing log homes, posts and poles, shingles, and lumber—but the operations are small.

Population in the Vicinity—In 1983 Jackson County had a population of about 1,800. Population of Walden in 1984 was 872. Annual per-capita income in Jackson County was $10,788 in 1985. Since 1980 the unemployment rate in Jackson County has varied from 5 to 9 percent.

The railhead city of Fort Collins (population 82,150) is in Larimer County where total population is 171,700 (1985). In 1986, 4.1 percent of the workforce in the county was unemployed. Annual per-capita income in Fort Collins was $10,514 in 1984.

BUREAU OF LAND MANAGEMENT FOREST

Area Name and Location—The Rock Creek area (figs. 2-7, 2-22, and 2-23), which lies at elevations from 9,500 to 10,500 feet at latitude 38°13' and longitude 106°58', is in the Montrose District of the Bureau of Land Management in Colorado. The administrative office for the area is in Gunnison.

The gross timbered area totals about 8,900 acres, of which about 90 percent is lodgepole pine type. The area is almost entirely within Saguache County (Saguache is the county seat) but has a small acreage in Gunnison County (Gunnison is the county seat). The area is centered around Summit Park and Rock Creek Park. It is 60 air miles due north of Pagosa Springs and 25 air miles south-southwest of Gunnison on a heading of 191°. Private land is interspersed with that administered by the Bureau of Land Management (fig. 2-22).

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Rock Creek Park, Rudolph Hill, Powderhorn, and Spring Hill Creek.

Access—The western portion of the area (vicinity of Polepatch Hill) is reached by road as follows (38 miles):

Gunnison to Blue Mesa Bridge via U.S. Highway No. 50	10 miles
Blue Mesa Bridge south on paved road to County Road No. 27	18 miles
County Road 27 (gravel) east to start of Road Beaver	4 miles
Road Beaver to start of North Beaver Creek Road	2 miles
Unimproved Road Beaver (from the North Beaver Creek junction) to the area border	4 miles

The northwest corner of the area is reached by about 3 miles of unimproved road up North Beaver Creek. The southern border of the area is reached by an improved road running north from the Los Pinos Pass road; an unimproved road extends to the eastern border. The northernmost portion of the area is not accessible by road (fig. 2-22).

The nearest railhead is Poncha Springs on a spur extending about 5 miles from Salida. For highway distances from Salida to various market centers in the United States, see table 1-2.

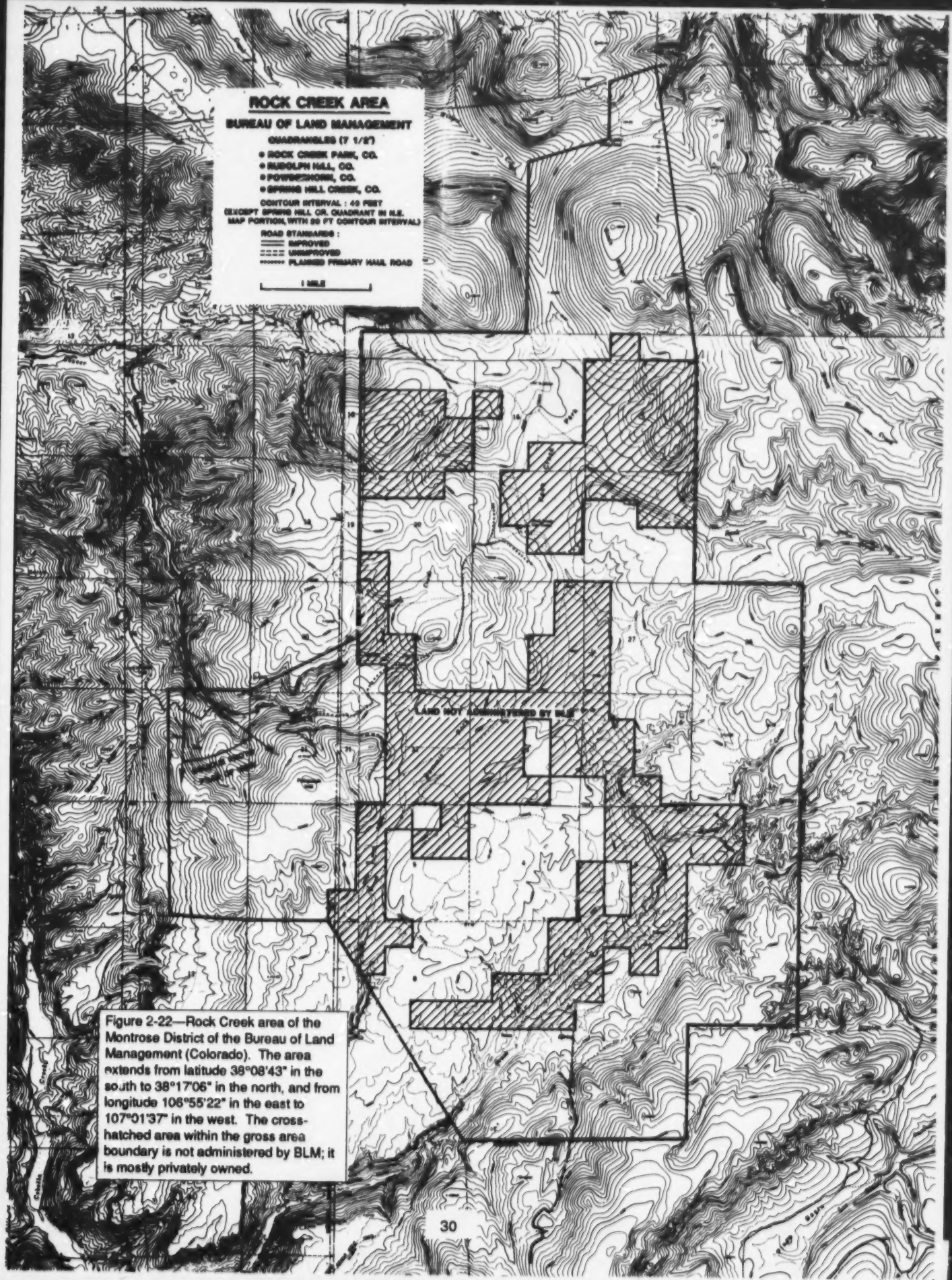
ROCK CREEK AREA
BUREAU OF LAND MANAGEMENT
QUADRANGLES (7 1/2')
• ROCK CREEK PARK, CO.
• RUDOLPH HILL, CO.
• POWDERHORN, CO.
• SPRING HILL CREEK, CO.
CONTOUR INTERVAL : 40 FEET
(EXCEPT SPRING HILL CR. QUADRANT IN N.E. MAP PORTION, WITH 20 FT CONTOUR INTERVAL)
ROAD STANDARDS :
IMPROVED
UNIMPROVED
PLANNED PRIMARY HAUL ROAD
1 MILE
LAND NOT ADMINISTERED BY BLM

Figure 2-22—Rock Creek area of the Montrose District of the Bureau of Land Management (Colorado). The area extends from latitude 38°08'43" in the south to 38°17'06" in the north, and from longitude 106°55'22" in the east to 107°01'37" in the west. The cross-hatched area within the gross area boundary is not administered by BLM; it is mostly privately owned.

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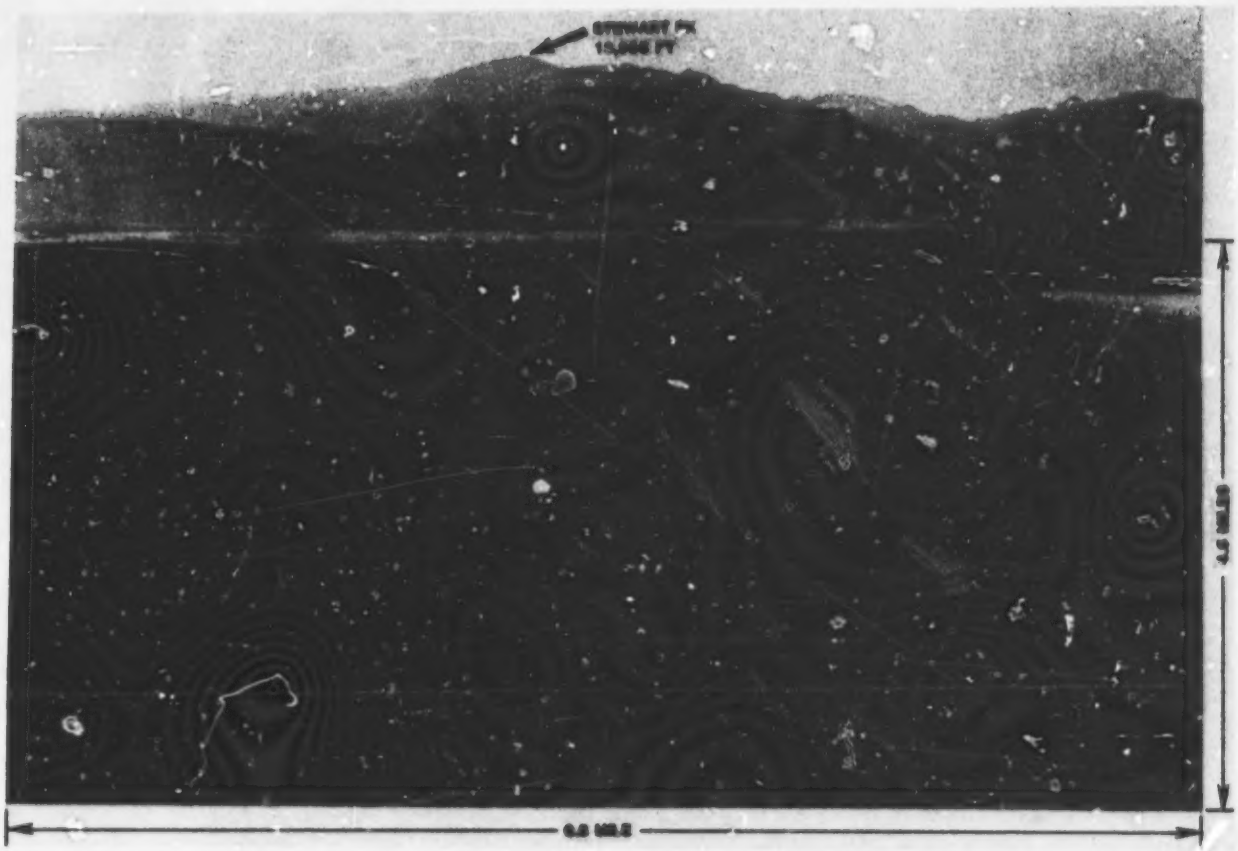

Figure 2-23—Oblique view of the Rock Creek area of the Montrose District of the Bureau of Land Management (Colorado) looking south-southeast from near Miller Hill; see figure 2-22 for camera viewpoint and field of view. Width of the foreground shown is about 0.8 mile; from foreground to Rock Creek in the mid-background is about 4½ miles.

Terrain and Soil—As previously noted, the timbered area lies mostly between 9,500 and 10,500 feet, with about 80 percent of the lodgepole pine timber type on slopes of less than 45 percent (fig. 2-23). Soils are gravelly sandy loam. Duff layer in the Polepatch Hill area was observed to be about 1 inch thick.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation is about 20 inches, with 1 to 1½ feet of snow on the ground common in midwinter. The snow-free season generally extends from mid-May through November.

General Character of the Timber—The lodgepole stands grade in continuums from stand to stand, but three stand types predominate: small sawtimber 7 to 12 inches in d.b.h. (fig. 2-24); pole stands with trees predominantly 3 to 4 inches in d.b.h. (fig. 2-25); and stagnated stands of small trees predominantly 1 to 3 inches in d.b.h. (fig. 2-26). Small sawtimber occurs on about 45 percent of the lodgepole pine acreage, pole stands on 40 percent, and "doghair" stands on about 5 percent.

There were extensive fires in the area 100 to 150 years ago; trees in current lodgepole pine stands are 95 to 130 years old.

At present, mortality caused by mountain pine beetle is not evident, nor is damage from porcupines. Dwarf mistletoe is absent, but some trees are cankered from various rusts, and butt scars from fire are evident in the Polepatch Hill area (fig. 2-24).

There has been no harvesting in the area except for a couple of hundred acres of small sawtimber harvested (107 acres clearcut and 84 acres in a partial cut) during 1986; the logs were transported about 100 miles to a flakeboard mill near Montrose.

Data on Sample Trees—To provide more than casual observational data descriptive of the trees, a pair of adjacent 3½- to 4-inch codominant trees were destructively sampled from a gentle slope north of Polepatch Hill (fig. 2-25). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties parallel to the grain at 10 percent moisture content.

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Figure 2-24—Lodgepole pine stand with some small sawtimber on Polepatch Hill of the Rock Creek area of the Montrose District of the Bureau of Land Management in Colorado. Fire scars are evident on butts of many trees here.

Figure 2-26—Stagnant stand of small lodgepole pine on Polepatch Hill of the Rock Creek area of the Montrose District of the Bureau of Land Management in Colorado. Trees measured 1 to 3 inches in d.b.h.

Figure 2-25—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled on Polepatch Hill in the Rock Creek area of the Bureau of Land Management.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.80	3.88
Tree height above 6-inch high stump, feet	24.3	29.3
Crown ratio, percent	43.1	39.5
Cone serotiny	closed	closed
Tree age years (number of annual growth rings)		
Stump height	110	102
20 percent of tree height	100	83
Base of live crown	50	51
Diameter inside bark, inches		
Stump height	3.70	4.10
20 percent of tree height	3.39	3.53
Base of live crown	2.32	2.77
Height from stump top to base of crown, inches	204	213
Stem taper inside bark, inches/ 100 inches		
Below crown	0.68	0.62
Within crown	2.64	1.99
Rings/inch, average for section		
Stump height	59	50
Base of live crown	43	37
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	99.3	104.7
Specific gravity, ovendry weight and green volume	0.395	0.398
Rings/inch in first 1¼ inches radius	46	30
Ultimate compresssive strength, lb f/in²	5,270	4,990
Proportional limit, lb f/in²	3,970	3,760

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Characteristic	Tree number 1	Tree number 2
Modulus of elasticity, lb f/in²	1,060,000	1,120,000
Compression wood evident?	none	slight
Spiral grain angle at surface, degrees	2	1
Bark thickness (single), inch	0.16	0.14
Pith eccentricity, inch	0.1	0.4

Inventory Data—Stand inventory data from 322 plots taken in 1981 and 1982 indicate that the basal area per acre averages 97 ft² (range 22 to 313), volume per acre in trees larger than 9 inches in d.b.h. averages 3,000 bd ft Scribner scale (range 1 to 24), and tree height averages 45 feet (maximum 116). For the Rock Creek study area sampled, diameter distribution averaged as follows:

D.b.h. class *Inches*	Lodgepole pine *Number of trees per acre*
<5.0	196
5.0-5.9	50
6.0-6.9	54
7.0-7.9	40
8.0-8.9	25
9.0-9.9	17
10.0-10.9	14
11.0-11.9	10
12.0-12.9	7
13.0-13.9	5
14.0-14.9	2
15.0-15.9	2
16.0+	2
Total	424

Cubic Yield Potential and Height Growth—Although not well documented, growth on the area is estimated at something more than 20 ft³ per acre per year. Fifty-year height growth in managed stands is estimated to be about 31 feet (range 15 to 57).

Management Objectives for the Area and Constraints—The long-term management objective for the area is to convert the presently unmanaged lodgepole stands to managed stands through regeneration-harvest methods and intermediate cutting treatments where appropriate. The protection and enhancement of big game habitat is also a primary objective. The area is managed for multiple use, and harvest plans will be evaluated for effects on the environment.

The primary obstacle to forest practices for accomplishment of objectives is lack of markets for stumpage. In 1986, sawtimber stumpage was sold at $10 per M bd ft Scribner log scale—a price insufficient to return the full cost of sawtimber sale preparation; moreover, there are few interested buyers even at this price. Subsawlog-size trees have virtually no market.

Other Lodgepole Pine Available in the Area From Public Lands—While not studied intensively, it is believed that additional large acreages of lodgepole pine are unavailable on other public lands in the vicinity.

Forest Products Industry in the Vicinity—There are no large forest industries immediately adjacent to the area. Major timber consumers in the region include a large sawmill cutting random-length dimension lumber, and a structural flakeboard plant—both near Montrose. A house log manufacturer operates in Poncha Springs.

There are three very small sawmills in Saguache. Monte Vista has a medium-size sawmill; Alamosa has a moderately large mill; and South Fork has a large stud mill and a medium-size sawmill for random-length dimension lumber. A small industry producing mine props and house logs operates in Creede.

Population in the Vicinity—As noted in comments about the Gunnison National Forest area, Gunnison County has a total population of 11,283 (1983), almost all of whom reside within 30 miles of Gunnison—the home of Western State College. Population within the limits of the town of Gunnison totals 5,902. In 1983 the per-capita income in Gunnison County was $7,874, with 5.9 percent of the workforce unemployed. Gunnison is a major tourist center.

As noted in comments on the Rio Grande National Forest, Saguache County has a total population of 3,946 (1985); population within the town of Saguache totals 625. In 1980 the per-capita income of Saguache County was $4,504, with 16 percent of the workforce unemployed in 1985.

REFERENCES

Benson, Robert E.; Green, Alan W. 1987. Colorado's timber resources. Resour. Bull. INT-48. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 53 p.

Van Hooser, Dwane D.; Chojnacky, David C. 1983. Whole tree volume estimates for the Rocky Mountain States. Resour. Bull. INT-29. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 69 p.

CHAPTER 3: IDAHO

INTRODUCTION

In Idaho, lodgepole pine predominates on about 2.3 million acres of the State's 14.0 million acres of commercial forest land, with about 4.1 billion ft³ of lodgepole pine growing stock and 11.6 billion bd ft of sawtimber (table 3-1). Approximately 13 percent of the softwood growing stock and 8 percent of the softwood sawtimber in the State is lodgepole pine (Benson and others 1987).

Approximately 52 percent of the dry weight of aboveground biomass of lodgepole pine trees in Idaho is in trees smaller than the 10-inch d.b.h. class (table 3-2).

The six areas selected for study by managers of the public forest lands in Idaho (fig. 3-1) total 78,840 acres in gross area; they are individually described in the following text.

Table 3-1—Volume of lodgepole pine growing stock and sawtimber, and acreage in lodgepole pine, by ownership class, Idaho[1]

Ownership class	Growing stock[2]	Sawtimber volume[3]	Commercial timberland area
	Million ft³	*Million bd ft International ¼-inch scale*	*Thousand acres*
National Forest (commercial)[4]	3,292.9	9,414.1	1,882.0
Other public	263.8	722.4	129.0
Forest industry	136.5	395.4	56.3
Other private	386.1	1,088.1	191.0
Total	4,079.3	11,620.0	[4]2,258.3

[1]Source: Benson and others (1987). Information presented is based on 1961 data.

[2]**Growing stock volume** = net volume in cubic feet of live sawtimber and pole timber trees (5 inches d.b.h. and larger) from stump to a minimum 4-inch top outside bark, or to the point where the central stem breaks into limbs.

[3]**Sawtimber volume** = net volume in board feet of the sawlog portion of live sawtimber trees. Sawtimber trees are live trees of commercial species, 9 inches in d.b.h. or larger (softwood), containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect.

[4]**Commercial timberland** = forest land that is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. Areas qualifying as commercial timberland have the capability of producing in excess of 20 ft³ per acre per year of industrial wood in natural stands.

Table 3-2—Dry weight of lodgepole pine trees, by tree component and diameter class—Idaho[1]

Diameter class	Bole[2]	Top[2]	Total
Inches	*--- Thousand tons, ovendry basis ---*		
2	—	1,237	1,237
4	—	6,200	6,200
6	9,319	5,470	14,789
8	13,614	3,567	17,181
10	12,631	2,908	15,539
12	8,289	2,054	10,343
14	4,338	962	5,300
16	2,320	500	2,820
18	1,130	216	1,346
20+	772	155	927
Total	52,413	23,269	75,682

[1]Source: Van Hooser and Chojnacky (1983).

[2]**Trees 5+ inches d.b.h.:** Bole weight = ovendry weight of wood and bark from a 1-foot stump to a 4-inch top diameter, inside bark; top weight = ovendry weight of wood and bark from a 4-inch diameter to tip of tree, plus branch material down to ¼-inch diameter.

Trees less than 5 inches d.b.h.: Total ovendry weight of wood and bark from a 1-foot stump to tip of tree, plus branch material down to ¼-inch diameter (tabulated under "Top").

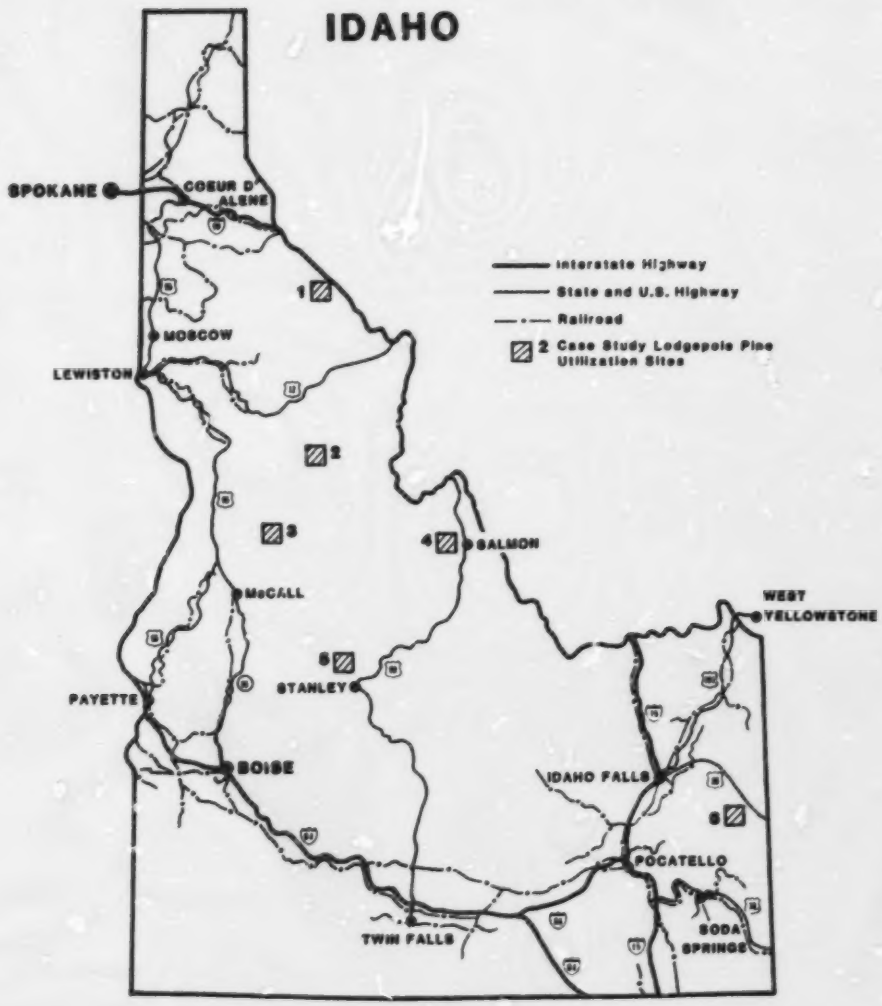

Figure 3-1—Idaho location map. 1. Panhandle NF (Wampus, Goat, Blackburn, and Heller Creeks) 3,900 acres. 2. Nez Perce NF (Kirks Fork) 5,040 acres. 3. Payette NF (Stratton Creek) 7,800 acres. 4. Salmon NF (Leesburg Basin) 31,700 acres. 5. Challis NF (Cape Horn) 3,400 acres. 6. Caribou NF (Brockman Road) 27,000 gross acres, of which about two-thirds are roadless; in roaded areas there are about 2,500 acres of lodgepole pine type forest.

CARIBOU NATIONAL FOREST

Area Name and Location—The Brockman Road area (figs. 3-2, 3-3, and 3-4), which lies at an elevation of 6,500 to 7,500 feet at latitude 43°11' and longitude 111°17', is in the Soda Springs District of the Caribou National Forest in Idaho. The Ranger Station is in Soda Springs.

The gross area is about 27,000 acres, but approximately two-thirds of these acres are unroaded and are mostly in grassland. Only about 2,500 acres are timbered in lodgepole pine type—all to the west of the major access road (Brockman Road) (fig. 3-3). The area falls entirely within Bonneville County; Idaho Falls is the county seat.

The center of the area is about 14 miles due west of Alpine and the south end of Palisades Reservoir; it is 39 air miles north-northeast of Soda Springs on a heading of 24°.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Herman, Big Elk Mountain, and Poker Peak.

Access—A dry-weather unimproved road (Brockman Road) gives access to the slopes along the grassy lower edge of the forested portion which lies along the western edge of the gross area (fig. 3-3). Caribou Basin Guard Station on the southern edge of the area (where Brockman Road joins the McCoy Creek Road) is 54 highway miles from Soda Springs and 19 miles to U.S. Highway No. 89 at Alpine.

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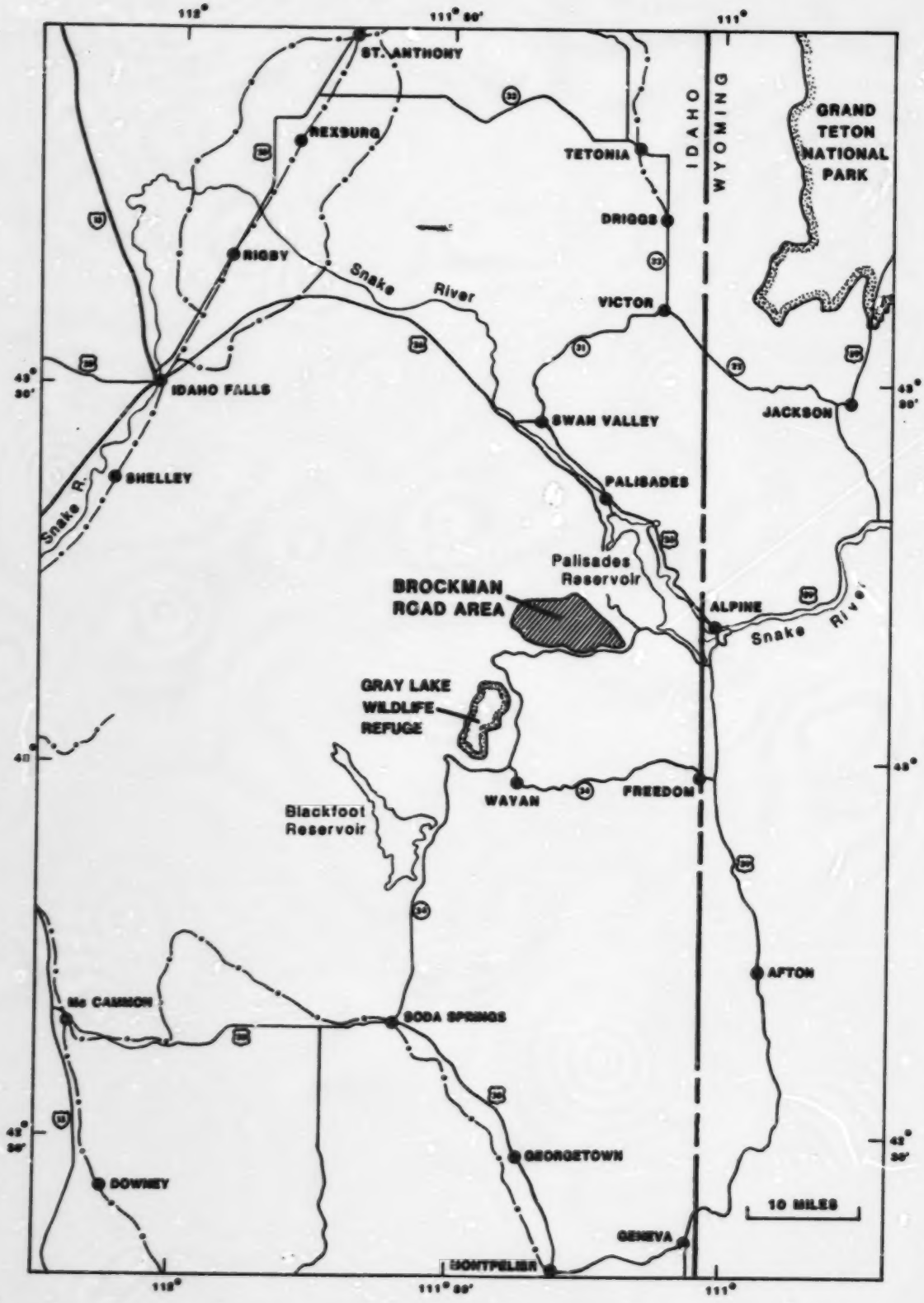

Figure 3-2—Vicinity map for the Brockman Road area of the Caribou National Forest in Idaho.

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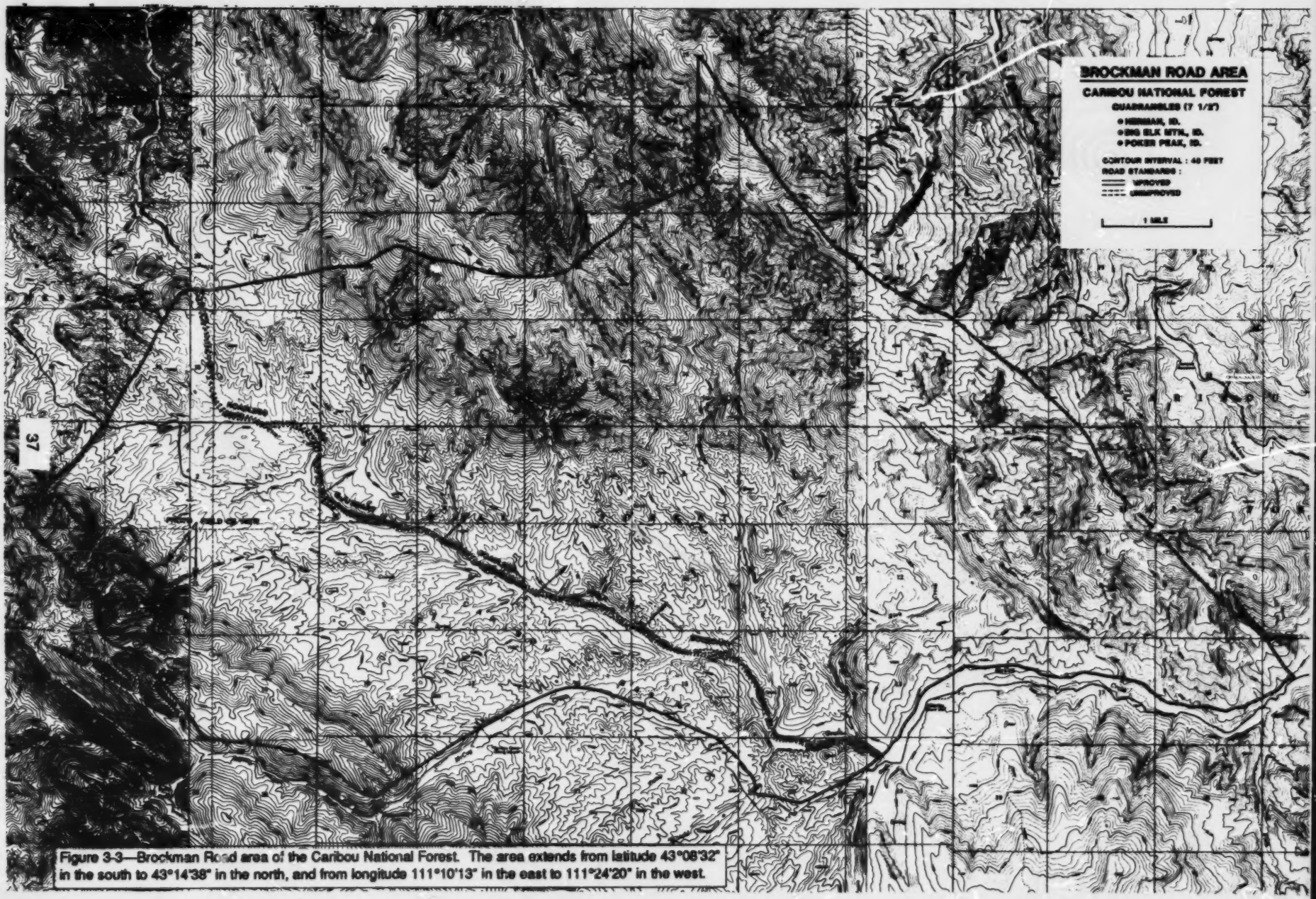

Figure 3-3—Brockman Road area of the Caribou National Forest. The area extends from latitude 43°08'32" in the south to 43°14'38" in the north, and from longitude 111°10'13" in the east to 111°24'20" in the west.

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Figure 3-4—View looking west from the access road in the north end of the Brockman Road area of the Caribou National Forest. The lodgepole pine is interspersed with stands of aspen. The ridge in the near background (the west border of the area) has maximum elevation of 7,500 feet. Meadows in the foreground are at 6,500 to 6,700 feet elevation. See figure 3-3 for approximate viewpoint and field of view.

The nearest railhead is Soda Springs. A more distant railhead is Idaho Falls, which is about 120 road miles from the Caribou Basin Guard Station via Alpine and U.S. Highway No. 89 (somewhat closer via Herman and Bone). For highway distances from Idaho Falls to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the timbered area lies between 6,500 and 7,500 feet elevation, with three-quarters or more of the lodgepole pine acreage on slopes of less than 45 percent. Soils are clay loam with very few rocks. Grassland borders the timber along lower edges (fig. 3-4).

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals about 20 inches, with 3 feet of snow on the ground common in winter. The snow-free season is generally from June 15 to November 15.

General Character of the Timber—Slopes timbered with lodgepole pine (mixed with alpine fir and containing extensive stringers of aspen) are in a band a couple of miles wide just east of the delineated western border of the area (fig. 3-3). The lodgepole pine is mostly in uneven-aged stands, with older trees up to 12 inches in d.b.h. intermingled with pole-size timber (fig. 3-5). Stands are not very dense. Fire has been absent for the past century, so mature stands range in age from 80 to 120 years.

Significant numbers of trees have been killed by mountain pine beetle, and dwarf mistletoe is generally present. Severe spiral grain is evident in some dead wood (fig. 3-6), but none was observed in a sampled pair of trees 3½ to 4 inches in d.b.h.

Except for some sanitation cuts, no significant harvests have been made, and none are in an advanced stage of planning.

Data on Sample Trees—A pair of adjacent 3½- to 4-inch codominants were destructively sampled at 6,500 feet close to Brockman Road in the center of the western edge of the delineated area (fig. 3-7). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

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Figure 3-5—Uneven-aged lodgepole pine in the Brockman Road area of the Caribou National Forest; stocking is not dense, dwarf mistletoe is widespread, and mortality from bark beetles is significant.

Figure 3-6—Spiral grain in lodgepole pine dead wood adjacent to Brockman Road in the Caribou National Forest.

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Figure 3-7—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled just west of Brockman Road in the central portion of the western edge of the Caribou National Forest area delineated in figure 3-3.

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Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	4.00	3.75
Tree height above 6-inch high stump, feet	37.5	41.2
Crown ratio, percent	50.7	42.3
Cone serotiny	open	open
Tree age years (number of annual growth rings)		
Stump height	34	37
20 percent of tree height	26	30
Base of live crown	20	19
Diameter inside bark, inches		
Stump height	4.28	3.87
20 percent of tree height	3.59	3.39
Base of live crown	3.08	2.72
Height from stump top to base of crown, inches	222	285
Stem taper inside bark, inches/100 inches		
Below crown	0.54	0.40
Within crown	1.35	1.30
Rings/inch, average for section		
Stump height	16	19
Base of live crown	13	14
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	102.6	123.0
Specific gravity, ovendry weight and green volume	0.385	0.359
Rings/inch in first 1¼ inches radius	13	17
Maximum crushing strength, lb f/in²	5,930	5,360
Proportional limit, lb f/in²	4,260	3,710
Modulus of elasticity, lb f/in²	1,160,000	1,220,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	0	1
Bark thickness (single), inch	0.10	0.08
Pith eccentricity, inch	0.4	0.3

Inventory Data—Inventory data for the 2,500 acres of lodgepole pine timber type are incomplete. Based on estimates of knowledgeable managers concerned with the area, however, the following tabulation approximates the diameter distribution in a couple of typical compartments:

D.b.h. class	Compartment #190	Compartment #191
Inches	*- - Number of live stems per acre - -*	
1	1,358	1,744
2	50	123
3	35	23
4	13	31
5	56	44
6	37	31
7	42	53
8	24	54
9	37	33
10	22	16
11	10	13
12	14	7
13	6	6
14	6	3
15	6	2
16	3	1
17	0	1
17+	9	2
Total	1,728	2,187

Cubic Yield Potential and Height Growth—Data are not well documented, but the managers estimate that lodgepole pine in the area is currently growing at the rate of 40 to 50 ft³ of stemwood per acre per year; for managed stands the potential is estimated at 80 ft³ per acre per year. Fifty-year height growth in managed stands is estimated to be about 55 feet.

Management Objectives for the Area and Constraints—Accomplishment of economically viable, phased, small-scale, clearcut harvests done in a manner to favor natural regeneration into vigorous, controlled-density stands, while enhancing stand diversity, wildlife habitat, and long-term watershed values is the major management objective.

The primary obstacle to forestry practices for accomplishment of the objective is lack of markets for small-diameter lodgepole pine.

Other Lodgepole Pine Available in the Area From Public Lands—In addition to the 2,500 acres of lodgepole pine type timber in the Brockman Road area, the Caribou National Forest probably has another 20,000 acres of similar timber in which existing area mills have little interest.

Forest Products Industry in the Vicinity—There are no large forest industries in the immediate area. Major timber consumers in the region include a large sawmill in Rexburg that manufactures random-length dimension lumber (mostly from species other than lodgepole pine) and a large stud mill in St. Anthony that does use lodgepole pine. Another large mill that manufactures lodgepole pine studs is located in Afton, WY.

Population in the Vicinity—Bonneville County had a total population of 74,775 in 1985; the county seat of Idaho Falls has a population of 43,433 (1985) within the town limits. In 1986 the per-capita income in the Idaho Falls trade area was $9,056; in the entire county, annual per-capita income in 1984 was $10,884. Of those in the workforce, 4.2 percent were unemployed during 1985 in Bonneville County.

Caribou County, with a 1980 population of 8,695, contains the nearest railhead at Soda Springs (population 4,051)—the county seat. In 1984 the annual per-capita income in Caribou County was $9,612, and 7.9 percent of those in the workforce were unemployed during 1985.

CHALLIS NATIONAL FOREST

Area Name and Location—The Cape Horn area (figs. 3-8, 3-9, and 3-10), which lies at an elevation of 6,700 to 7,400 feet at latitude 44°22' and longitude 115°05', is in the Yankee Fork Ranger District of the Challis National Forest. The Ranger Station is in Clayton, ID.

The gross area of about 3,400 acres includes about 2,750 acres of lodgepole pine timber type and falls entirely within Custer County, ID; Challis is the county seat. The area lies just east of the Cape Horn Forest Service Guard Station (fig. 3-9), immediately south of the Frank Church-River of No Return Wilderness. From Stanley, ID, the area is 14 air miles northwest on a heading of 330°.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Langer Peak and Elk Meadow.

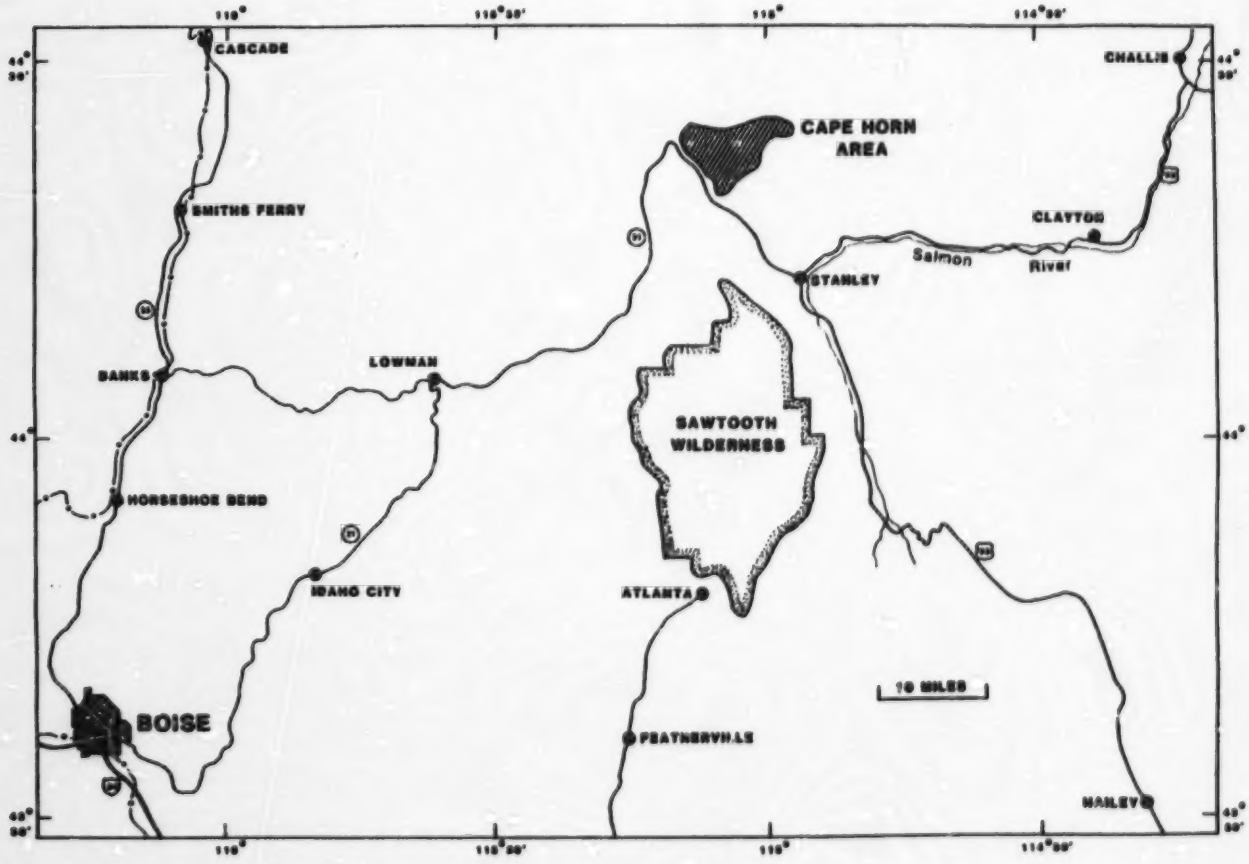

Figure 3-8—Vicinity map for the Cape Horn area of the Challis National Forest in Idaho.

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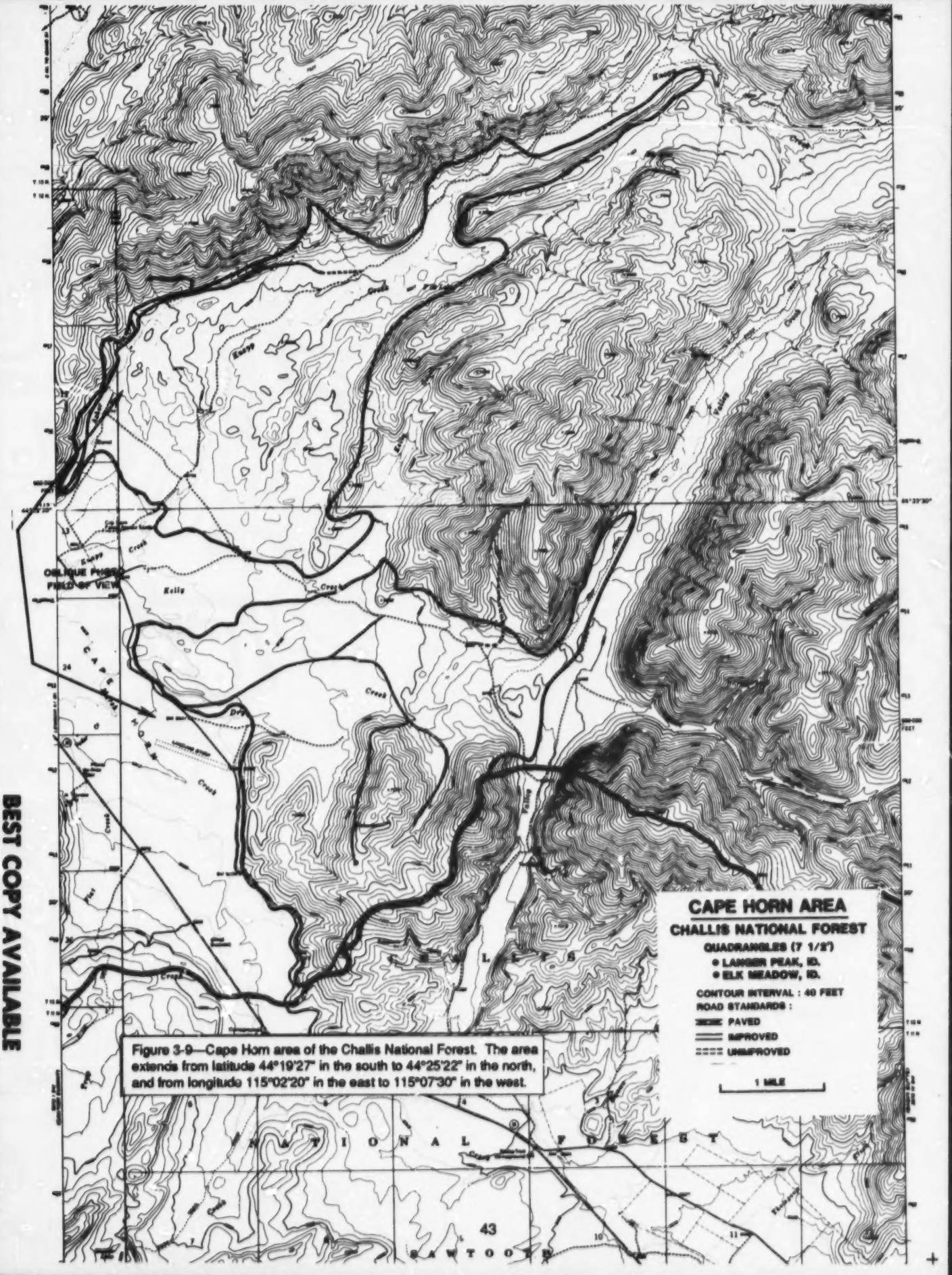
CAPE HORN AREA
CHALLIS NATIONAL FOREST
QUADRANGLES (7 1/2')
• LANGER PEAK, ID.
• ELK MEADOW, ID.
CONTOUR INTERVAL : 40 FEET
ROAD STANDARDS :
PAVED
IMPROVED
UNIMPROVED
1 MILE
OBLIQUE PHOTO FIELD OF VIEW
CAPE HORN
Kelly
Creek
Valley
Langer Creek
Elk Meadow
Cougar Mountain
Ridge
Trail
Pass
Mountain
Peak
Lake
Basin
Flat
Meadow
Spring
Cabin
Ranger Station
Campground
Trailhead
Bridge
Ford
Dam
Airstrip
Lookout
Mine
Tunnel
Falls
Rapids
Glacier
Snowfield
Forest Service Road
Trail
Boundary
Township
Section
Quadrangle
Contour
Index Contour
Intermediate Contour
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Depression Contour
Cliff
Escarpment
Saddle
Divide
Ridge
Spur
Gully
Draw
Canyon
Gorge
Valley

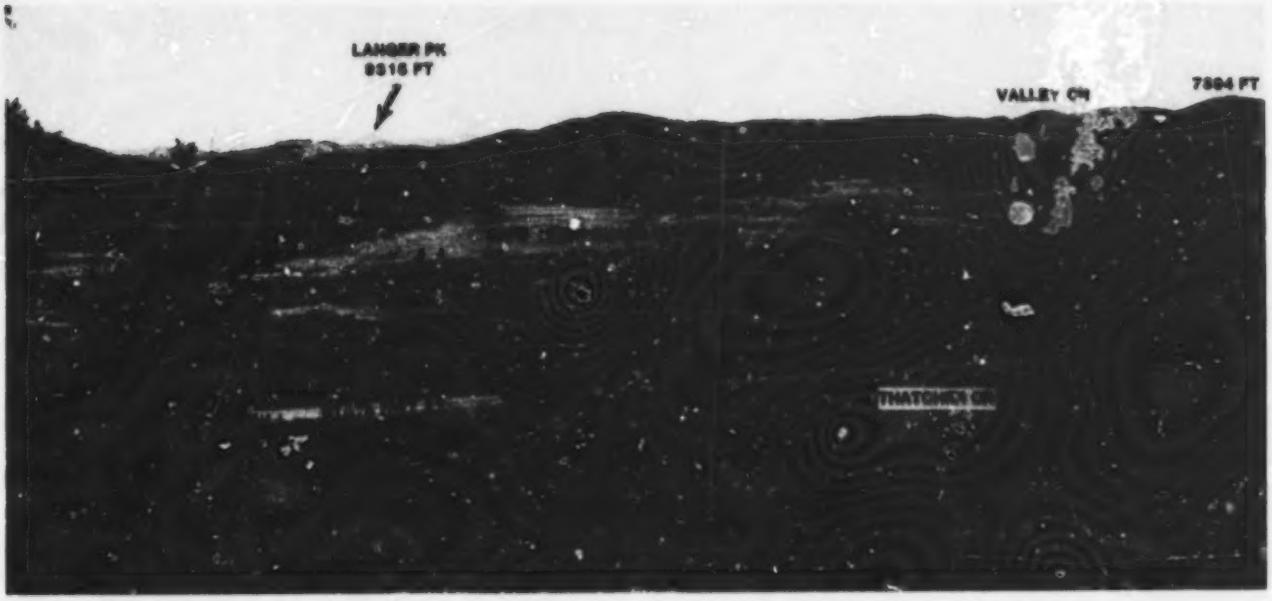

Figure 3-10—Oblique view of the Cape Horn area of the Challis National Forest looking east-northeast from near the Thatcher Creek Campground. The straight-line distance from State Highway No. 21 in the foreground to the Cape Horn Guard Station in midview is about 1¼ miles.

Access—From Stanley, it is 21 miles northwest via State Highway No. 21 to the turnoff to the Cape Horn Guard Station, and then about 2 miles east to the Station (figs. 3-8 and 3-9), from whence improved and unimproved roads give access to Asher Creek, Knapp Creek, and Dry Creek.

The nearest railhead is the town of Banks on a Union Pacific spur track that roughly parallels State Highway No. 55 between Boise and McCall. From the Cape Horn Guard Station it is about 70 miles to Banks via paved road to Lowman and gravel road from Lowman to Banks (fig. 3-8). Somewhat more distant—about 120 road miles—is the railhead at Boise. Snow intermittently closes roads to both Banks and Boise.

For highway distances from Boise to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the lodgepole pine timber lies between 6,700 and 7,400 feet and is on level to gently sloping ground interspersed with meadows (fig. 3-10). Soils are decomposed granite. There are no special obstacles to harvesting, except deep snow and extreme cold in winter.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation is about 30 inches, mostly falling as snow. The snow-free season generally extends from mid-June to the end of October. Winter temperatures may be as low as –50 °F.

General Character of the Timber—Lodgepole pine in the area grows on flats interspersed with meadows; these flats are evidently frost pockets that deter growth of other conifers. Stands are uneven aged, not very dense, and infested with dwarf mistletoe. Trees tend to be limby. D.b.h. ranges from 1 inch to a maximum of about 12 inches, but most are in the range from 4 to 7 inches (figs. 3-11 and 3-12).

At present, mortality caused by mountain pine bark beetles is not evident, nor is damage from porcupines. Trees are not excessively cankered.

Past harvesting activity has been sporadic and minor. The road network through the area was built to gain access to more valuable timber at higher elevations. Current activity is limited to small-scale post and pole harvests for local use.

Data on Sample Trees—A pair of adjacent 3½- to 4-inch codominants were destructively sampled at 6,800 feet from gently sloping terrain between Valley Creek and Dry Creek (fig. 3-12). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

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Figure 3-11—Stagnated, deteriorating, small-pole stand along Asher Creek in the Cape Horn area of the Challis National Forest.

Figure 3-12—Pair of codominant trees 3½ to 4 inches in d.b.h. sampled between Valley Creek and Dry Creek in the Cape Horn area of the Challis National Forest.

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Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.63	3.78
Tree height above 6-inch high stump, feet	26.0	36.7
Crown ratio, percent	65.4	53.2
Cone serotiny	open	open
Tree age years (number of annual growth rings)		
Stump height	53	62
20 percent of tree height	41	41
Base of live crown	32	25
Diameter inside bark, inches		
Stump height	3.63	4.01
20 percent of tree height	3.40	3.35
Base of live crown	3.15	2.68
Height from stump top to base of live crown, inches	108	206
Stem taper inside bark, inches/100 inches		
Below crown	0.44	0.65
Within crown	1.54	1.15
Rings/inch, average for section		
Stump height	29	31
Base of live crown	20	19
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	135.1	117.6
Specific gravity, ovendry weight and green volume	0.385	0.415
Rings/inch in first 1¼ inches radius	19	24
Maximum crushing strength, lb f/in²	4,410	5,550
Proportional limit, lb f/in²	2,280	3,720
Modulus of elasticity, lb f/in²	640,000	970,000
Compression wood evident?	slight	slight
Spiral grain angle at surface, degrees	1	2
Bark thickness (single), inch	0.11	0.14
Pith eccentricity, inch	0.2	0.1

Inventory Data—Inventory data for the 2,750 acres of lodgepole pine timber type are incomplete. Based on estimates of knowledgeable managers concerned with the area, however, the following tabulation approximates the diameter distribution of a typical acre:

D.b.h. class *Inches*	Number of live stems per acre
<2.9	30
3.0-3.9	103
4.0-4.9	130
5.0-5.9	150
6.0-6.9	120
7.0-7.9	80
8.0-8.9	20
9.0-9.9	15
10.0+	10
Total	658

Cubic Yield Potential and Height Growth—Although data are not well documented, managers estimate that the current lodgepole pine forests in the area are growing about 20 ft³ per year; the potential is estimated at 30 ft³ per year. Fifty-year height growth in managed stands is estimated at 40 to 50 feet.

Management Objectives for the Area and Constraints—It is the objective of managers of the area to improve timber quality and growth rate through harvest and regeneration into vigorous managed stands while enhancing wildlife habitat and watershed values. Also, visual quality of the timbersheds must be protected. The major deterrent to accomplishing this objective is lack of markets for small lodgepole pine timber.

Other Lodgepole Pine Available in the Area From Public Lands—In the immediate area (west across State Highway No. 21), the Challis National Forest has another 3,000 to 4,000 acres of similar lodgepole pine timber.

Farther west, in the Landmark-Bear Valley country of central Idaho, the Lowman Ranger District of the Boise National Forest administers more than 10,000 additional acres of this timber type.

Forest Products Industry in the Vicinity—There are no large forest industries immediately adjacent to the area. More than 100 miles distant to the southwest and northwest, however, there are large sawmills at railheads in New Meadows, Cascade, Horseshoe Bend, and Emmett. In Emmett there is also a plywood plant.

Population in the Vicinity—Custer County has a total population (1987) of 5,000; 1,200 reside in the county seat of Challis and 147 in the town of Stanley which—as noted previously—is only 21 miles from the area. In 1984, annual per-capita income in Custer County was $7,890. During 1985, 5.6 percent of those in the workforce were unemployed.

The railhead city of Boise (population 110,000) is in Ada County, which in 1986 had a total population of 195,200 and average per-capita income of $10,841. In 1986, 4.2 percent of those in the Ada County workforce were unemployed.

NEZ PERCE NATIONAL FOREST

Area Name and Location—The Kirks Fork area (figs. 3-13, 3-14, and 3-15), which lies at an elevation of 4,300 to 6,300 feet at latitude 45°51' and longitude 115°21', is in the Elk City Ranger District of the Nez Perce National Forest; the Ranger Station is in Elk City.

The gross area of about 5,040 acres includes about 4,300 acres of lodgepole pine timber type and falls entirely within Idaho County; Grangeville is the county seat. The area is immediately east of Elk City; from Grangeville the area is 40 air miles east-southeast on a heading of 102°.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Elk City and Black Hawk Mountain.

Access—From Elk City, a gravel road extends 4 miles to the northwest corner of the area but does not penetrate it; also, two gravel roads give access to the southwest and south perimeter of the area (fig. 3-14). Paved (but narrow) State Highways No. 14 and No. 13 run 64 miles from Elk

City down a gentle grade along the South Fork of the Clearwater River to the railhead at Kooskia, where No. 13 joins U.S. Highway No. 12 leading to the Snake River port of Lewiston, ID—60 highway miles farther west.

The nearest railhead is Grangeville, also reached via State Highway No. 14 down the South Fork of the Clearwater River to a junction 49 miles from Elk City from whence it traverses a steep climb 5 miles west to Grangeville.

For highway distances from Grangeville to major market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 4,300 and 6,300 feet elevation, with about two-thirds of the acreage having slopes of less than 45 percent. Soils are decomposed granite overlayed by 6 to 12 inches of volcanic ash. There are no special obstacles to harvesting.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals 36 to 40 inches, about half falling as snow. The snow-free season usually extends from June 1 through mid-October. Midwinter temperatures generally fall to –25 °F for a few days.

General Character of the Timber—Trees in the northwest quarter are mostly from 4 to 11 inches in d.b.h., 50+ feet tall, and about 60 years old (figs. 3-16 and 3-17). There is little down timber in this quarter and ground cover indicates a good site for lodgepole pine. No mortality from mountain pine beetle is evident, and porcupine damage is absent. Little dwarf mistletoe is present. A few of the stems have forks, a few have cankers, and there is a tendency to retain small dead limbs—but in general the lodgepole appears to be of good quality.

The southwest half is composed of dense stands of small timber lacking sufficient vigor to warrant thinning. The northeast portion is a mosaic of meadows, open-grown stands, and dense stands.

The last major fire in the area was in 1919. There has been no harvesting activity in the area, and none is currently planned.

Data on Sample Trees—A pair of adjacent codominants 3½ to 4 inches in d.b.h. were destructively sampled from a level site at 4,600 feet elevation in the northwest corner of the area (fig. 3-17). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties parallel to the grain at 10 percent moisture content.

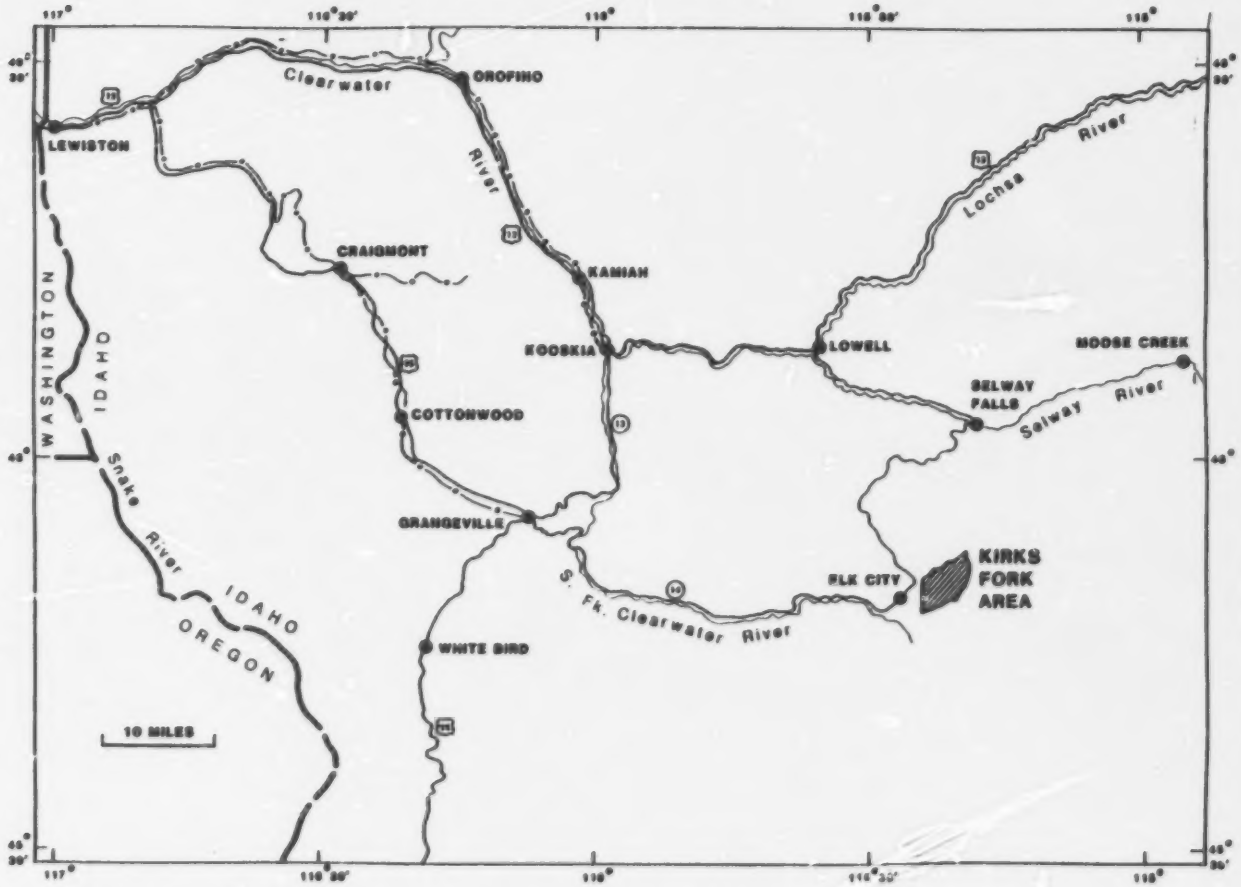

Figure 3-13—Vicinity map for the Kirks Fork area of the Nez Perce National Forest in Idaho.

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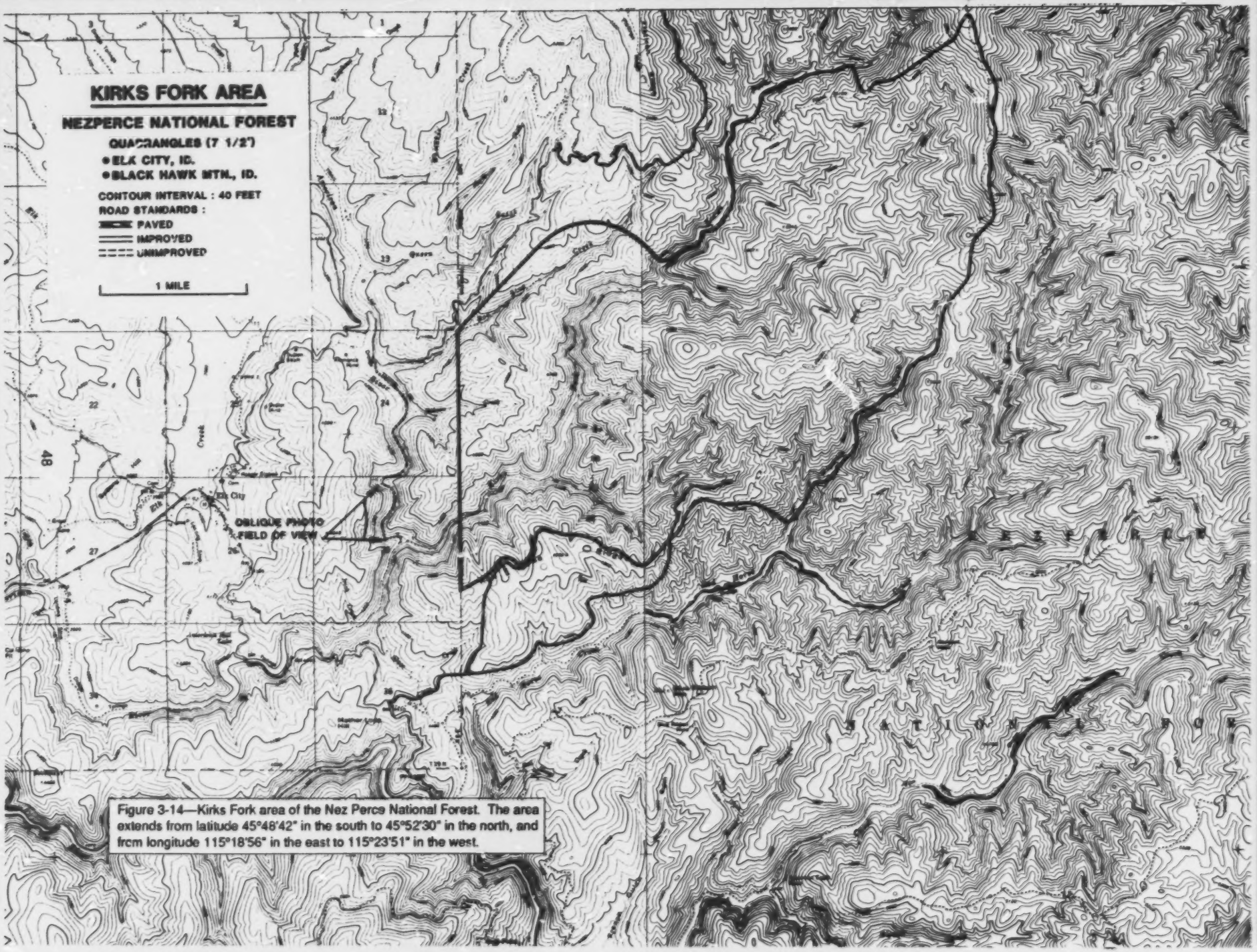

Figure 3-14—Kirks Fork area of the Nez Perce National Forest. The area extends from latitude 45°48'42" in the south to 45°52'30" in the north, and from longitude 115°18'56" in the east to 115°23'51" in the west.

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Figure 3-15—Oblique view of Kirks Fork area of the Nez Perce National Forest looking northeast across Anderson River up Kirks Fork and Baboon Creek; see figure 3-14 for camera viewpoint and field. Width of the background is about 5 miles; from the foreground to the timbered ridge on the left skyline is about 4 miles.

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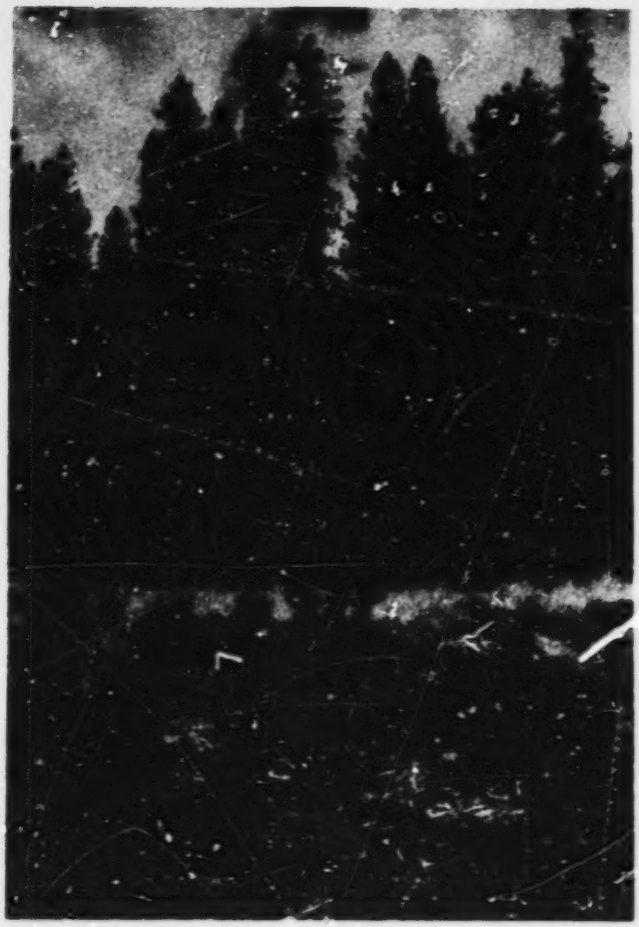

Figure 3-16—Tall, straight lodgepole pines 4 to 11 inches in d.b.h. and about 60 years old in northwest corner of Kirks Fork area of the Nez Perce National Forest. In the foreground, thrifty lodgepole natural regeneration is visible in a beargrass opening resulting from a small clearcut.

Figure 3-17—Pair of codominant trees 3½ to 4 inches in d.b.h. sampled at 4,600 feet in the northwest corner of the Kirks Fork area of the Nez Perce National Forest.

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Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.81	3.82
Tree height above 6-inch high stump, feet	52.0	54.5
Crown ratio, percent	43.3	32.7
Cone serotiny	closed	closed
Tree age years (number of annual growth rings)		
Stump height	61	61
20 percent of tree height	50	50
Base of live crown	34	30
Diameter inside bark, inches		
Stump height	3.65	3.98
20 percent of tree height	3.45	3.31
Base of live crown	2.52	2.01
Height from stump top to base of crown, inches	354	440
Stem taper inside bark, inches/100 inches		
Below crown	0.32	0.45
Within crown	0.93	0.94
Rings/inch, average for section		
Stump height	33	31
Base of live crown	27	30
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	74.6	92.0
Specific gravity, ovendry weight and green volume	0.452	0.450
Rings/inch in first 1¼ inches radius	14	13
Ultimate compressive strength, lb f/in²	5,370	6,100
Proportional limit, lb f/in²	3,980	5,120
Modulus of elasticity, lb f/in²	1,420,000	1,520,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	2	3
Bark thickness (single), inch	0.13	0.11
Pith eccentricity, inch	0.1	0.1

Inventory Data—Inventory data on the area are incomplete. Based on estimates of knowledgeable managers concerned with the area, however, the following tabulation approximates diameter distribution on a typical acre:

D.b.h. class *Inches*	Number of live stems per acre
<2.9	68
3.0-4.9	79
5.0-6.9	76
7.0-8.9	100
9.0+	43
Total	366

Cubic Yield Potential and Height Growth—Although not well documented, it is estimated that the potential growth of lodgepole pine forests in the area is 40 to 50 ft³ per acre per year. Fifty-year height growth in a managed stand is estimated to be about 50 feet.

Management Objectives for the Area and Constraints—The southwest third of the area is managed primarily for big game winter range, but this does not preclude harvest activities. Timber production is the major objective on the balance of the area, together with protection of wildlife habitat and watershed values. For ecological reasons, road construction will be limited to one or two consecutive seasons per decade. The major obstacle to accomplishing management objectives is lack of markets for subsawlog-size lodgepole pine and the associated grand fir and Douglas-fir.

Other Lodgepole Pine Available in the Area From Public Lands—East and south of Elk City, on the adjacent Red River District of the Nez Perce National Forest, lies more than 100,000 additional acres of similar lodgepole pine timber type. Because of anadromous fish habitat on this district, however, harvest activities must be more carefully planned than on some other districts.

Forest Products Industry in the Vicinity—In Elk City there is a large sawmill cutting random-length dimension lumber, but this mill is designed for fairly large logs rather than small-diameter lodgepole pine. The railhead towns of Kooskia and Grangeville each have sizable sawmills cutting random-length dimension lumber from a variety of species, and there is a sawmill in Cottonwood that cuts primarily ponderosa pine. Lewiston has the largest integrated utilization complex in the extended area; it includes a kraft pulp mill and lies at the head of barge navigation on the Snake River.

Population in the Vicinity—In 1980 Idaho County had a total population of 14,769; 3,660 reside within the limits of the town of Grangeville. In 1983 the per-capita income in Idaho County was $8,456, with 11.8 percent of the workforce unemployed.

IDAHO PANHANDLE NATIONAL FORESTS

Area Name and Location—The Wampus, Goat, Blackburn, and Heller Creeks area (figs. 3-18, 3-19, and 3-20), which lies at an elevation of 4,700 to 7,300 feet at latitude 47°05' and longitude 115°13', is in the Avery Ranger District of the Idaho Panhandle National Forests (hereinafter referred to as Panhandle); the Ranger Station is in Avery.

The gross area of about 3,900 acres includes about 3,120 acres of lodgepole pine timber type and falls entirely within Shoshone County; Wallace is the county seat. The area is just north of the St. Joe River at its junction with Heller Creek; the Montana-Idaho line forms the northeast border of the area, which is centered on a line between Simmons Peak in the west and Binocular Peak in the east (figs. 3-19 and 3-20). From Avery the area is 30 air miles southeast on a heading of 115°, and from the Missoula airport it is 52 air miles west-northwest on a heading of 283°.

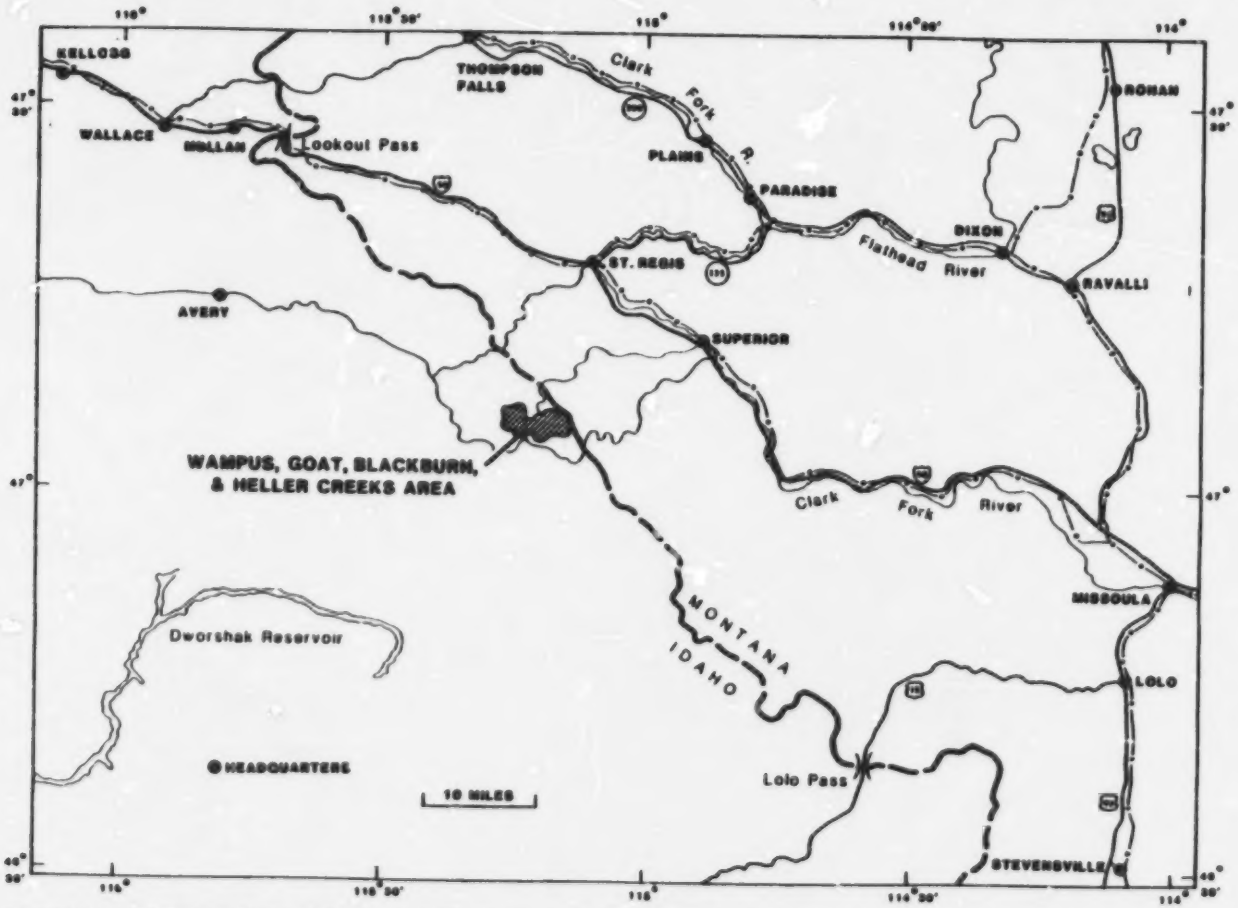

Figure 3-18—Vicinity map for the Wampus, Goat, Blackburn, and Heller Creeks area of the Idaho Panhandle National Forests in Idaho.

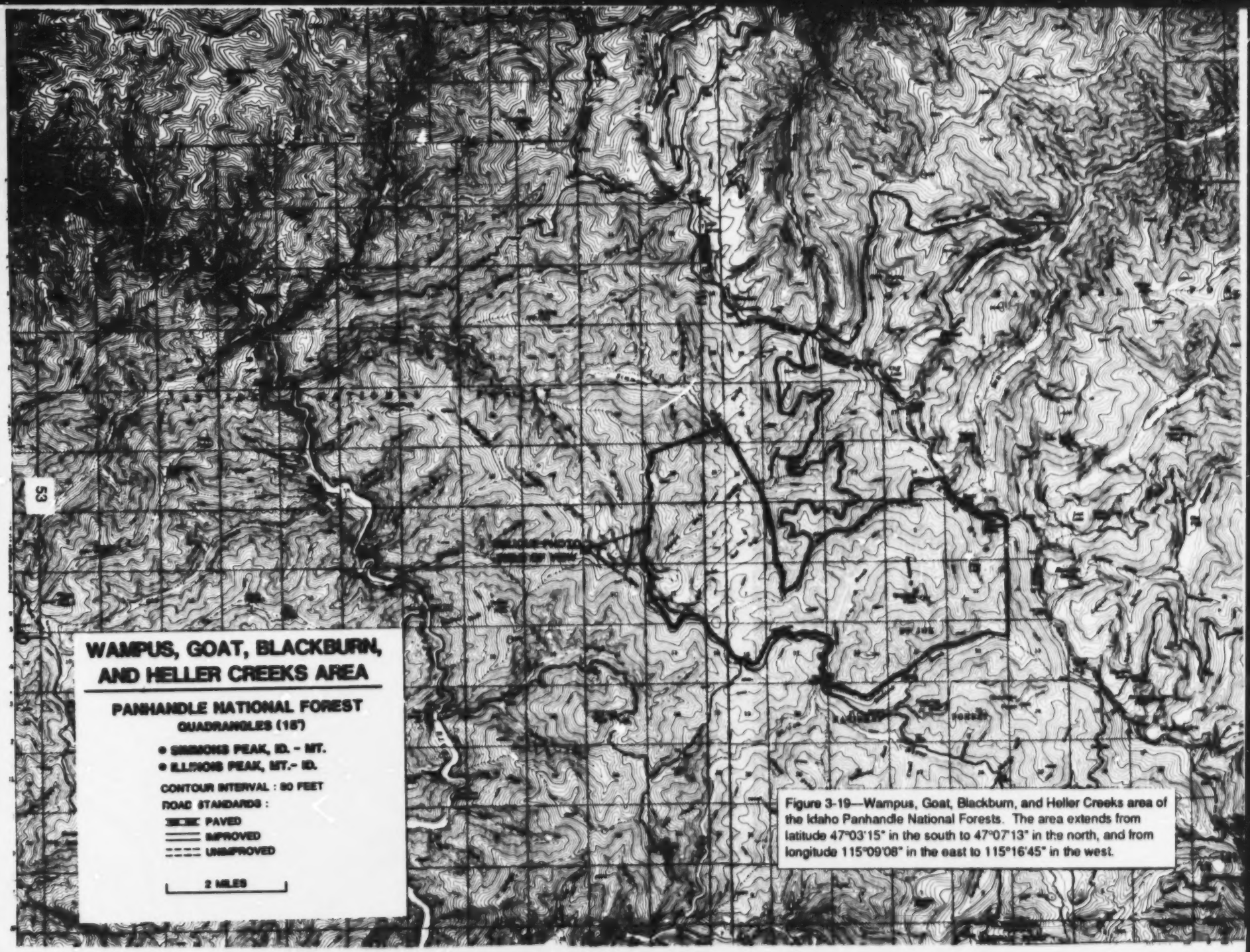

Figure 3-19—Wampus, Goat, Blackburn, and Heller Creeks area of the Idaho Panhandle National Forests. The area extends from latitude 47°03'15" in the south to 47°07'13" in the north, and from longitude 115°09'08" in the east to 115°16'45" in the west.

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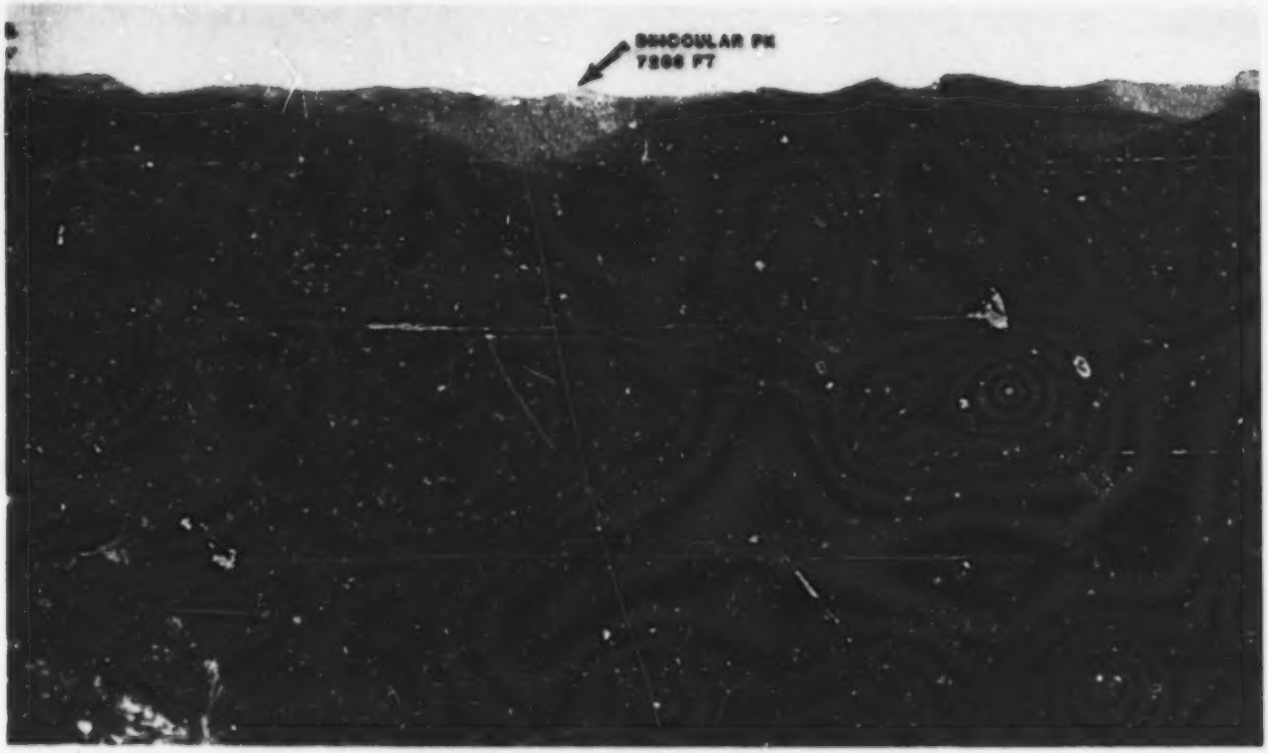

Figure 3-20—Oblique view of the Wampus, Goat, Blackburn, and Heller Creeks area of the Idaho Panhandle National Forests from Simmons Peak (6,700 feet) immediately west of the area delineated on figure 3-19. From camera viewpoint to Binocular Peak on the horizon is about 6½ miles.

Maps of the Area—USGS quadrangle 15' maps needed to depict the area are: Simmons Peak, ID-MT, and Illinois Peak, ID-MT.

Access—Easiest access to the area is from the railhead (Burlington Northern) town of St. Regis via a paved road running 29 miles southwest over a 5,813-foot pass at the Montana-Idaho border to where Gold Creek enters the St. Joe River (elevation 3,343 feet). This stream intersection can also be reached by gravel road up the St. Joe River from St. Maries and Avery. From where Gold Creek enters the St. Joe River, it is 10 miles via gravel road west up the St. Joe to Red Ives Ranger Station. From the station, an unimproved dirt road runs an additional 9 miles to the southwest border of the area (elevation 6,060 feet), where there is a branch road leading to Simmons Peak; the main road runs another 3 miles to where Heller Creek empties into the St. Joe River (elevation 4,693 feet). Improved roads also lead from the north-central edge of the area to St. Regis and to Superior (figs. 3-18 and 3-19).

For highway distances from St. Regis to various market centers in the United States, see table 1-2.

Terrain and Soil—The timbered area lies mostly between 4,700 and 6,500 feet, with nearly seven-eighths of the lodgepole pine acreage having slopes of more than 45 percent. Soils are weathered parent material overlayed with volcanic ash of variable depth. Steep slopes and difficult access are the primary obstacles to harvesting.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation in the area totals 50 inches at lower elevations and 60 inches at upper, most of which falls as snow. The snow-free season generally extends from mid-July to mid-October.

General Character of the Timber—At 6,000 feet elevation the lodgepole pines are open grown, fairly short, tapered, and limby. At lower elevation near the creek bottoms, trees are taller, somewhat less limby, and stands have denser stocking (fig. 3-21). Near Heller Creek, where it empties into the St. Joe River, wind breakage of the lodgepole pine is significant; forked stems are prevalent, and many are broken at forks and cankers.

Most of the trees are 5 to 10 inches in d.b.h. and 60 to 75 years old (smaller-diameter trees may be only 45 years old). The largest trees measure about 20 inches in d.b.h. Breast-height growth of a 9.2-inch tree southeast of the Heller Creek campground (elevation 4,693 feet) averaged 11.5 rings per inch.

Several trees (9 to 11 inches in d.b.h.) growing at 3,700 feet near the Red Ives Station showed breast-height growth of 8 to 10 rings per inch, which is quite rapid for lodgepole pine in the intermountain region.

In general, however, tree quality within the delineated area is probably below average for all the areas studied. Subalpine fir and mountain hemlock are prevalent at higher elevations, and stringers of fir/hemlock extend into the lodgepole pine.

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Figure 3-21—Lodgepole pine stand viewed looking northeast from junction of Heller and Sherlock Creeks (elevation 4,700 feet). Trees are mostly 5 to 11 inches in d.b.h.

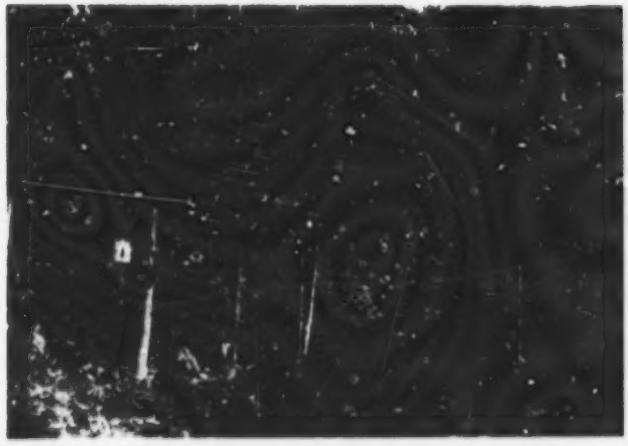

Figure 3-22—Pair of adjacent sample trees 3½ to 4 inches in d.b.h. in tall understory of lodgepole pine stand at 6,060 feet on level terrain just south of Blackburn Creek on the Idaho Panhandle National Forests.

No mortality from mountain pine beetles is evident, and porcupine damage is absent. Dwarf mistletoe is present in some stands, but is not considered a serious problem.

There has been no harvesting in the area, and none is planned for the immediate future. The last general fires to burn in the area were in 1889 and 1910.

Data on Sample Trees—A pair of adjacent 3½- to 4-inch trees from the tall understory of a stand at 6,060 feet on level terrain just south of Blackburn Creek were destructively sampled (fig. 3-22). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.78	3.75
Tree height above 6-inch high stump, feet	26.0	31.0
Crown ratio, percent	55.1	68.3
Cone serotiny	open	open
Tree age years (number of annual growth rings)		
Stump height	45	45
20 percent of tree height	35	33
Base of live crown	27	27
Diameter inside bark, inches		
Stump height	3.83	3.88
20 percent of tree height	3.50	3.29
Base of live crown	2.90	2.95
Height from stump top to base of live crown, inches	140	118
Stem taper inside bark, inches/100 inches		
Below crown	0.65	0.79
Within crown	1.69	1.16
Rings/inch, average for section		
Stump height	23	23
Base of live crown	19	18
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	114.2	87.9
Specific gravity, ovendry weight and green volume	0.400	0.439
Rings/inch in first 1¼ inches radius	14	14
Ultimate compresssive strength, lb f/in²	4,510	5,060
Proportional limit, lb f/in²	2,720	1,830
Modulus of elasticity, lb f/in²	640,000	1,020,000
Compression wood evident?	significant	significant
Spiral grain angle at surface, degrees	0	1
Bark thickness (single), inch	0.12	0.12
Pith eccentricity, inch	0.2	0.3

Inventory Data—Inventory data are incomplete. As noted previously, most of the stands have trees predominantly 5 to 10 inches in d.b.h., with stand density varying inversely with elevation. Based on estimation of knowledgeable managers concerned with the area, however, the following approximates diameter distribution in typical lodgepole pine stands at a medium elevation of about 5,200 feet:

D.b.h. class *Inches*	Number of live stems per acre
<2.9	100
3.0-4.9	300
5.0-6.9	385
7.0-8.9	116
9.0+	28
Total	929

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Cubic Yield Potential and Height Growth—Although not well documented, it is estimated that such typical lodgepole pine stands in the area are growing about 136 ft³ of wood per acre per year. Fifty-year height growth in managed stands is estimated at about 50 feet.

Management Objectives for the Area and Constraints—It is the objective of managers responsible for the area to accomplish phased harvests and to naturally regenerate with vigorous, young, controlled-density stands of lodgepole pine, while protecting wildlife habitat, esthetic, and watershed values. The major obstacles to accomplishment of the objective are lack of access, steep terrain, and lack of markets for small-diameter lodgepole pine and alpine fir of relatively low quality.

Other Lodgepole Pine Available in the Area From Public Lands—The Avery Ranger District has at least 60,000 acres of lodgepole pine timber type in addition to that within the delineated area. Acreage of similar timber in adjacent ranger districts was not explored.

Forest Products Industry in the Vicinity—There are no large forest industries immediately adjacent to the area. In Superior there is a large sawmill cutting random-length dimension lumber; in St. Regis there is one manufacturer of house logs. In Missoula, which is 72 miles from St. Regis, there are several large sawmills, a particleboard plant, and a kraft pulpmill.

Population in the Vicinity—In 1986 Shoshone County, ID, had a total population of 16,440; 1,786 people reside in the county seat of Wallace, and 2,500 in Kellogg. Annual per-capita income in the county is about $15,000; approximately 30 percent of the workforce was unemployed in 1986.

Adjacent Mineral County in Montana had a total population in 1984 of 3,700, with 1,054 residing in the county seat of Superior. St. Regis has perhaps half the population of Superior. Per-capita income in Mineral County averaged $9,638 in 1984; in 1986, 8.8 percent of those in the workforce were unemployed.

PAYETTE NATIONAL FOREST

Area Name and Location—The Stratton Creek area (figs. 3-23, 3-24, 3-25, and 3-26), which lies at an elevation of 5,800 to 7,700 feet at latitude 45°17' and longitude 115°44', is in the McCall Ranger District of the Payette National Forest; the Ranger Station is in McCall.

The gross area of about 7,800 acres is essentially all timbered with lodgepole pine (together with a little alpine fir). It lies entirely within Idaho County; Grangeville is the county seat. The area is centered around Stratton Creek; it is just northwest of the town of Warren immediately west of Warren Creek and north of the Warren Wagon Road. The center of the area is about 10 miles south of the Salmon River and 32 air miles northeast of McCall on a heading of 35°.

Map of the Area—The USGS metric quadrangle map (30 by 60 minutes) needed to depict the area is Warren, ID.

Access—From McCall a paved road runs northeast 30 miles over Secesh Summit (6,376 feet) to where the road branches to Burgdorf and to Warren; from this point a gravel road runs east 10 miles to Steamboat Summit (6,694 feet) at the southernmost perimeter of the area, and then drops another 3 miles to the Warren Creek Gaging Station (5,836 feet) and the airstrip and town of Warren. This gravel road is not plowed in winter; winter mail is delivered intermittently to Warren by airplane.

An unimproved dirt road runs from the Burgdorf-Warren intersection northwest to the Salmon River and downstream west to Riggins—a distance of about 45 miles.

The nearest railhead is Cascade, 20 miles south of McCall. There is also a railhead at Tamarack, 20 miles west of McCall. For highway distances from McCall to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the timbered area lies between 5,800 and 7,700 feet elevation, with about half the acreage on slopes of less than 50 percent (figs. 3-25 and 3-26). The better sites are on relatively flat ground. Soils are sandy, of variable depth, and derived from granitics. Large stones or stone outcroppings are not evident, and there are no special terrain obstacles to harvesting. Considerable private land (mining claims) lies along Warren Creek to the east of the area (fig. 3-26).

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals 25 to 28 inches, most of which falls as snow. The snow-free season generally extends from about June 1 to late November.

General Character of the Timber—Much of the area was logged (high-graded) in the 1930's to provide fuel for the gold dredges in Warren. Because of these harvests, many of the current stands have dual age classes (fig. 3-27) in which the overstory measures 8 to 10 inches in d.b.h. and the understory is less than 3 inches in d.b.h. Along upper Stratton Creek the overstory is decadent with significant mortality evident.

Just west of Warren Creek there are uniform pole stands about 80 years of age (fig. 3-28).

About half the trees bear open cones, and half closed. Mortality from mountain pine beetle was heavy in the 1930's, but beetle mortality is not currently evident. Some stands have significant dwarf mistletoe infestation.

Except for very small-scale firewood and post and pole operations, no harvests are planned for the immediate future because of lack of markets.

Data on Sample Trees—A pair of adjacent 3½- to 4-inch codominants on gently sloping terrain (5,900 feet) just north of Stratton Creek and about one-fourth mile west of Warren Creek were destructively sampled (fig. 3-28). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representing all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

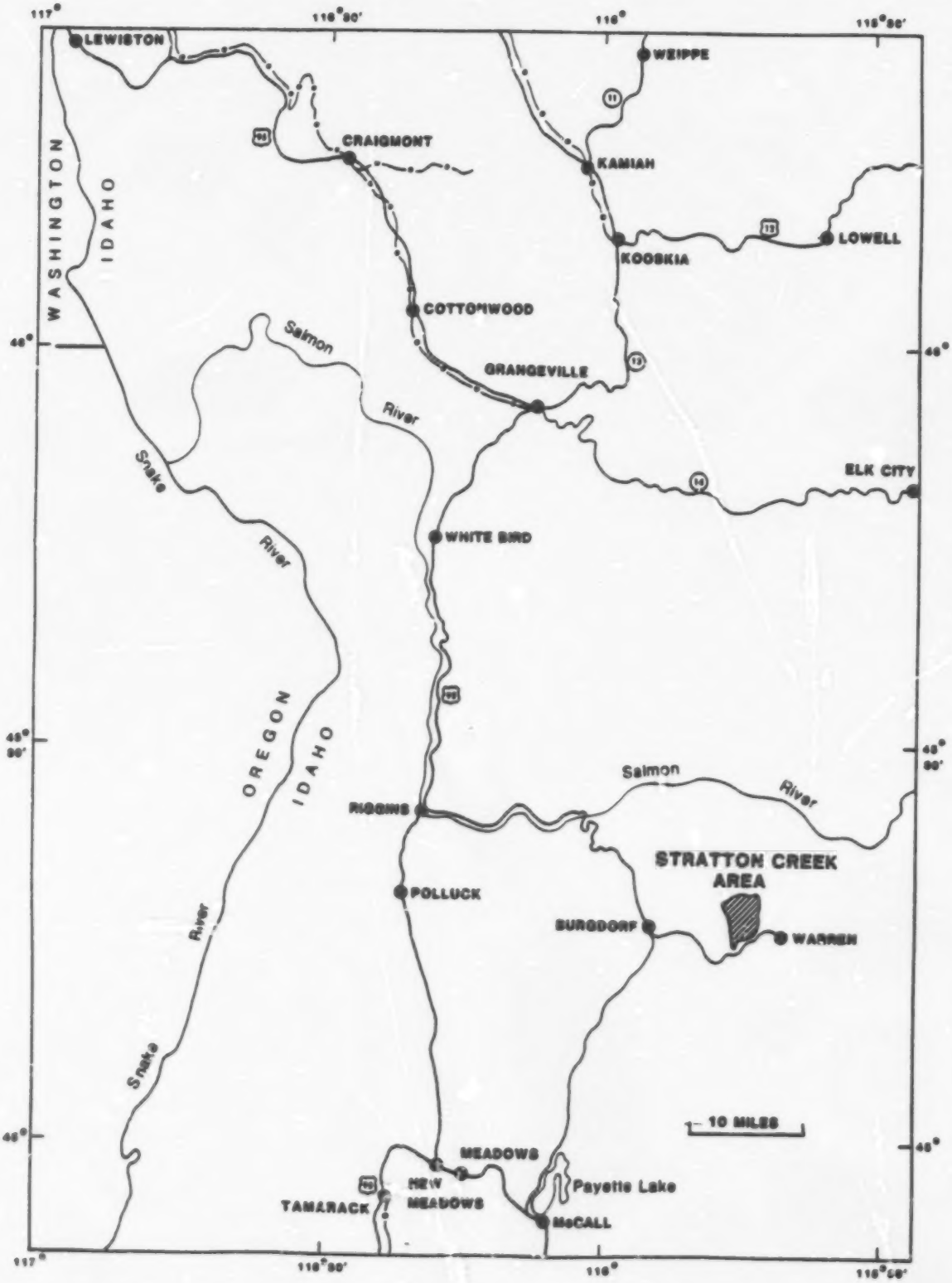

Figure 3-23—Vicinity map for the Stratton Creek area of the Payette National Forest in Idaho.

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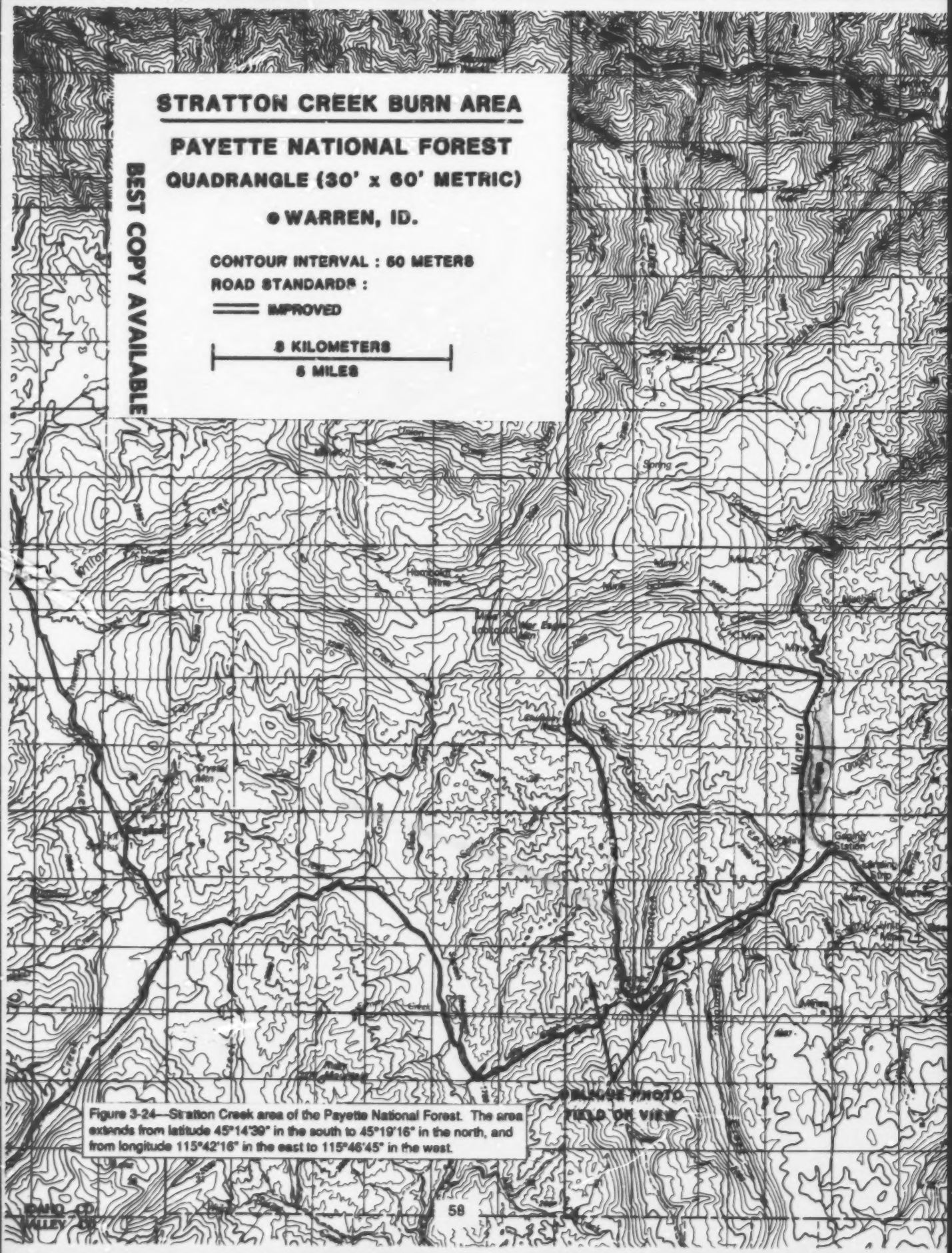

Figure 3-24—Stratton Creek area of the Payette National Forest. The area extends from latitude 45°14'39" in the south to 45°19'16" in the north, and from longitude 115°42'16" in the east to 115°46'45" in the west.

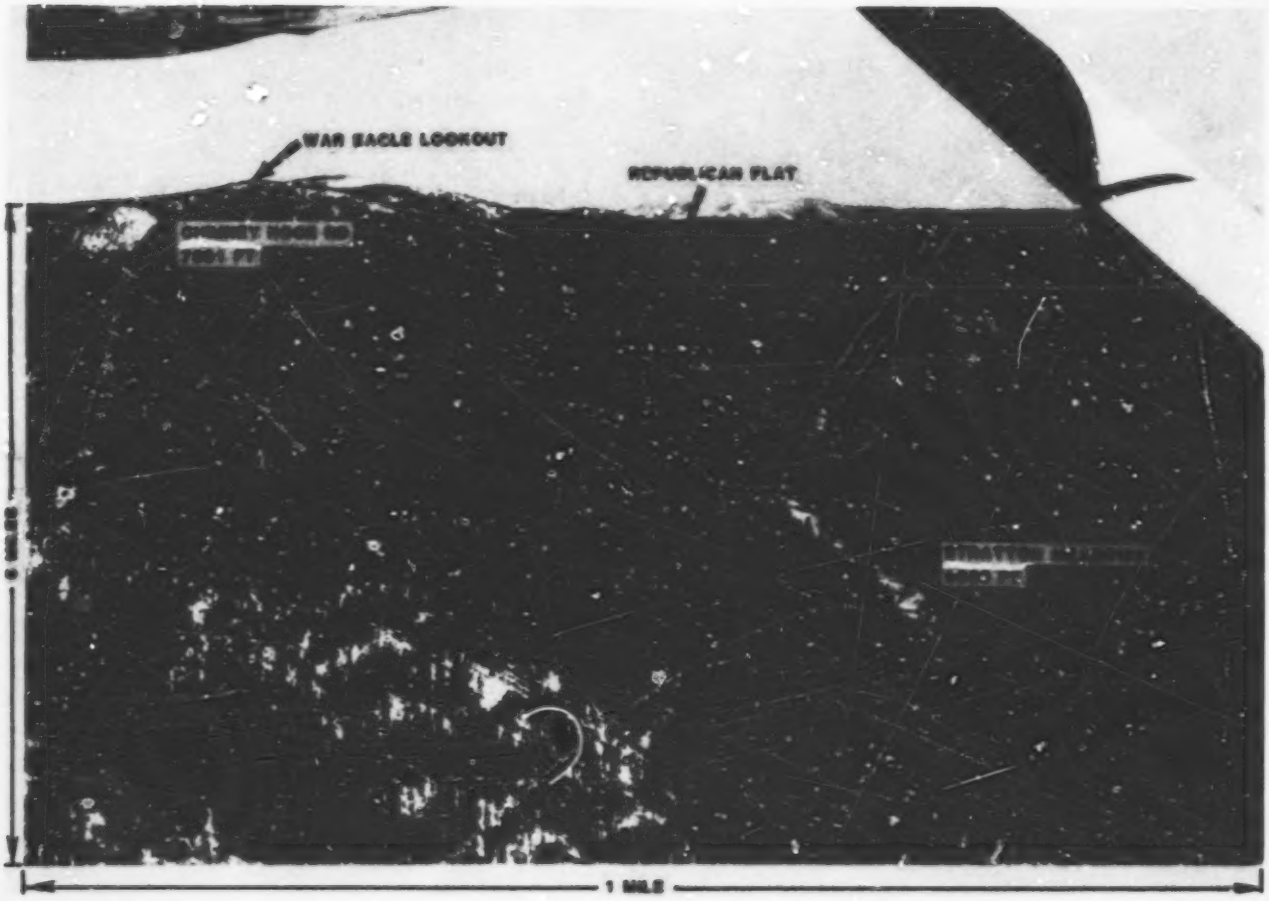

Figure 3-25—Aerial view of the Stratton Creek area of the Payette National Forest looking north from near Steamboat Summit (see fig. 3-24 for viewpoint and field of view). From the foreground to War Eagle Lookout on the left horizon is about 5 miles. The distance east to west in the foreground is about 1 mile.

Figure 3-26—View from Warren Creek near the gaging station looking north-northwest over gold-dredge tailings toward pole stands on Thomas Creek and beyond to Republican Flat. The sample point was at extreme left.

Figure 3-27—Dual-age class stand at about 6,800 feet adjacent to Steamboat Summit and Stratton Creek typical of acreages logged in the 1930's to provide fuel for gold dredges operating in Warren at that time. Mortality in the overstory trees (8 to 10 inches in d.b.h.) is significant.

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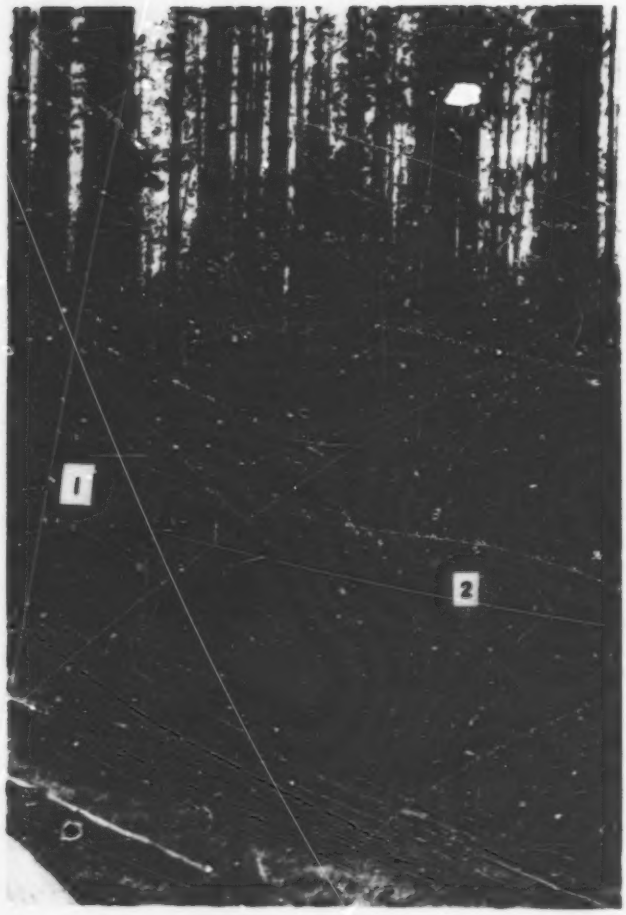

Figure 3-28—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled at 5,900 feet just north of Stratton Creek about one-fourth mile west of Warren Creek on the Payette National Forest.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.65	3.88
Tree height above 6-inch high stump, feet	41.5	43.3
Crown ratio, percent	26.5	30.4
Cone serotiny	closed	closed
Tree age years (number of annual growth rings)		
Stump height	78	82
20 percent of tree height	53	60
Base of live crown	33	40
Diameter inside bark, inches		
Stump height	3.76	3.92
20 percent of tree height	3.16	3.51
Base of live crown	1.80	2.12
Height from stump top to base of live crown, inches	366	362
Stem taper inside bark, inches/100 inches		
Below crown	0.54	0.50
Within crown	1.36	1.34
Rings/inch, average for section		
Stump height	41	42
Base of live crown	37	38
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry	60.1	63.6
Specific gravity, ovendry weight and green volume	0.438	0.443
Rings/inch in first 1¼ inches radius	24	28
Maximum crushing strength, lb f/in²	5,920	5,910
Proportional limit, lb f/in²	4,440	2,990
Modulus of elasticity, lb f/in²	980,000	1,100,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	3	2
Bark thickness (single), inch	0.10	0.07
Pith eccentricity, inch	0.1	0.1

Inventory Data—Inventory data on the area are incomplete. About 25 percent of the 7,800-acre area carries dual-aged stands of lodgepole (fig. 3-27) and about 75 percent even-aged pole stands (fig. 3-28). Typical stand data for these two stand types have been estimated by experienced managers responsible for the area, as follows:

D.b.h. class	Dual-age timber type	Pole timber type
Inches	*Number of live stems per acre*	
<2.9	600	200
3.0-3.9	120	70
4.0-4.9	120	30
5.0-5.9	18	13
6.0-6.9	18	13
7.0-7.9	12	22
8.0-8.9	12	21
9.0+	20	9
Total	920	378

Cubic Yield Potential and Height Growth—Although not well documented, it is estimated that potential growth rate in managed stands on the area should be about 50 ft³ per acre per year. Fifty-year height growth in managed stands is estimated at 30 to 90 feet.

Management Objectives for the Area and Constraints—Phased harvest of existing stands and replacement with vigorous natural regeneration managed for stocking control and stand diversity is the major objective of managers of the area. Such stand replacements would be done in a manner to enhance wildlife habitat and watershed values over the long term. That portion of the Warren Creek drainage more than a mile distant from the

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Salmon River, while replete with trout, is not considered anadromous fish habitat.

The principal obstacle to accomplishing management objectives is lack of markets for small-diameter lodgepole pine.

Other Lodgepole Pine Available in the Area From Public Lands—In addition to the Stratton Creek area, the Warren Creek drainage of the McCall Ranger District has another 30,000 acres (approximate) of similar lodgepole pine timber type.

Forest Products Industry in the Vicinity—There are no large forest industries immediately adjacent to the area. South and west of McCall there are large sawmills in Cascade, Council, and Tamarack—the latter with a cogeneration powerplant. More distant to the southwest is a large sawmill and plywood plant in Emmett, ID. To the north there are large sawmills in Grangeville and Kooskia. Few of the mills are equipped, however, to efficiently utilize small lodgepole pine logs.

Population in the Vicinity—In 1980 Idaho County had a total population of 14,769; 3,660 reside within the limits of the town of Grangeville—the county seat. The village of Warren has a post office, but only a few year-round residents. In 1983 the annual per-capita income in Idaho County was $8,456, with 11.8 percent of the workforce unemployed.

Valley County, with a population of 6,600, reports 2,568 residing in McCall. The county seat is the railhead town of Cascade (population 1,095). In 1982, annual per-capita income in Valley County was $11,265; 10.8 percent of those in the workforce were unemployed in May 1986. Adams County, which lies immediately west of McCall, had an unemployment rate of 19.9 percent in May 1986.

SALMON NATIONAL FOREST

Area Name and Location—The Leesburg Basin area (figs. 3-29, 3-30, and 3-31), which lies at an elevation of 6,100 to 8,600 feet at latitude 45°13' and longitude 114°07', is in the Cobalt Ranger District of the Salmon National Forest. The Ranger Station is in Salmon (Cobalt in summer only).

The gross area of about 31,700 acres is essentially all forested with lodgepole pine timber type. It falls entirely within Lemhi County; Salmon is the county seat. The area is centered around the old (virtually deserted) mining town of Leesburg, which is about 11 miles south of the Salmon River and 11 air miles northwest of the town of Salmon on a heading of 287°.

Maps of the Area—USGS quadrangle 15' maps needed to depict the area are: Ulysses Mountain and Leesburg.

Access—The most direct road access is south from Salmon 6 miles by paved road (U.S. Highway No. 93) to a gravel road running 13 miles northwest up Williams Creek to a 7,814-foot divide, then 7 miles down Moccasin Creek to its confluence with Napius Creek, and hence north on an unimproved dirt road 6.4 miles to Leesburg town site—a total road distance from Salmon to Leesburg of 32.4 miles. The area can also be reached from the gravel road that runs through Cobalt along Panther Creek to Shoup and North Fork on the Salmon River.

From Salmon, ID, railheads are distant, as follows:

Darby, MT (via 7,014-foot Lost Trail Pass)	77 miles
Red Rock siding south of Dillon, MT	90 miles
Arco, ID	138 miles
Roberts, ID	144 miles

For highway distances from Darby, MT, to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the timbered area lies between 6,100 and 8,600 feet elevation, with more than 90 percent of the acreage having slopes of less than 45 percent (fig. 3-31). There are no special terrain obstacles to harvesting.

Approximately 10 percent of the area has clayey soils derived from Challis Volcanics. About 35 percent of the soils are granitics, generally sandy loam or loamy sands. Most of the remaining soils are derived from quartzite parent material and are quite thin, with a high percentage of angular gravel and cobble. The quartzite soils are quite resistant to erosion due to the rock fragments.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals about 25 inches, with several feet of snow accumulation common in winter. The snow-free season along Napius Creek is generally from mid-May to mid-October.

General Character of the Timber—Of the total area of 31,700 acres, perhaps 25 percent is in old-growth sawtimber, mostly 9 to 11 inches in d.b.h. About 15 percent of the acreage is in pole stands (fig. 3-32). Most of the rest is in uneven-aged stands with timber of low quality (figs. 3-33, 3-34, and 3-35).

In the early 1930's there was a major mountain pine beetle infestation throughout the area, but current mortality from beetles is not evident. This epidemic had a significant impact on current stand conditions, yielding a high percentage of low-quality, low-volume stands. A significant proportion of trees observed along Napius Creek have cankers (fig. 3-34) and/or fire scars on the lower one-third of stems. Dwarf mistletoe infestation is prevalent.

The last fires that burned significant portions of the area occurred around 1900. In the late 1800's and early 1900's timber was cut to clear areas for placer mining, and to produce the firewood and lumber needed for mining activities.

Currently there is no significant managed harvesting activity in the area. The Salmon National Forest draft Forest Plan lists the Leesburg area in Management Area 5B, with emphasis on medium levels of timber outputs and investments. Currently (November 1986) the Plan calls for a 10-year timber harvest of about 14 million bd ft of sawtimber (Scribner log scale) from about 2,000 acres in the study area. This would require about 40 miles of permanent roads and is dependent on timber market conditions. Planned 10-year harvest of about 12 million bd ft of timber from adjacent areas will be dependent on this road system and market conditions.

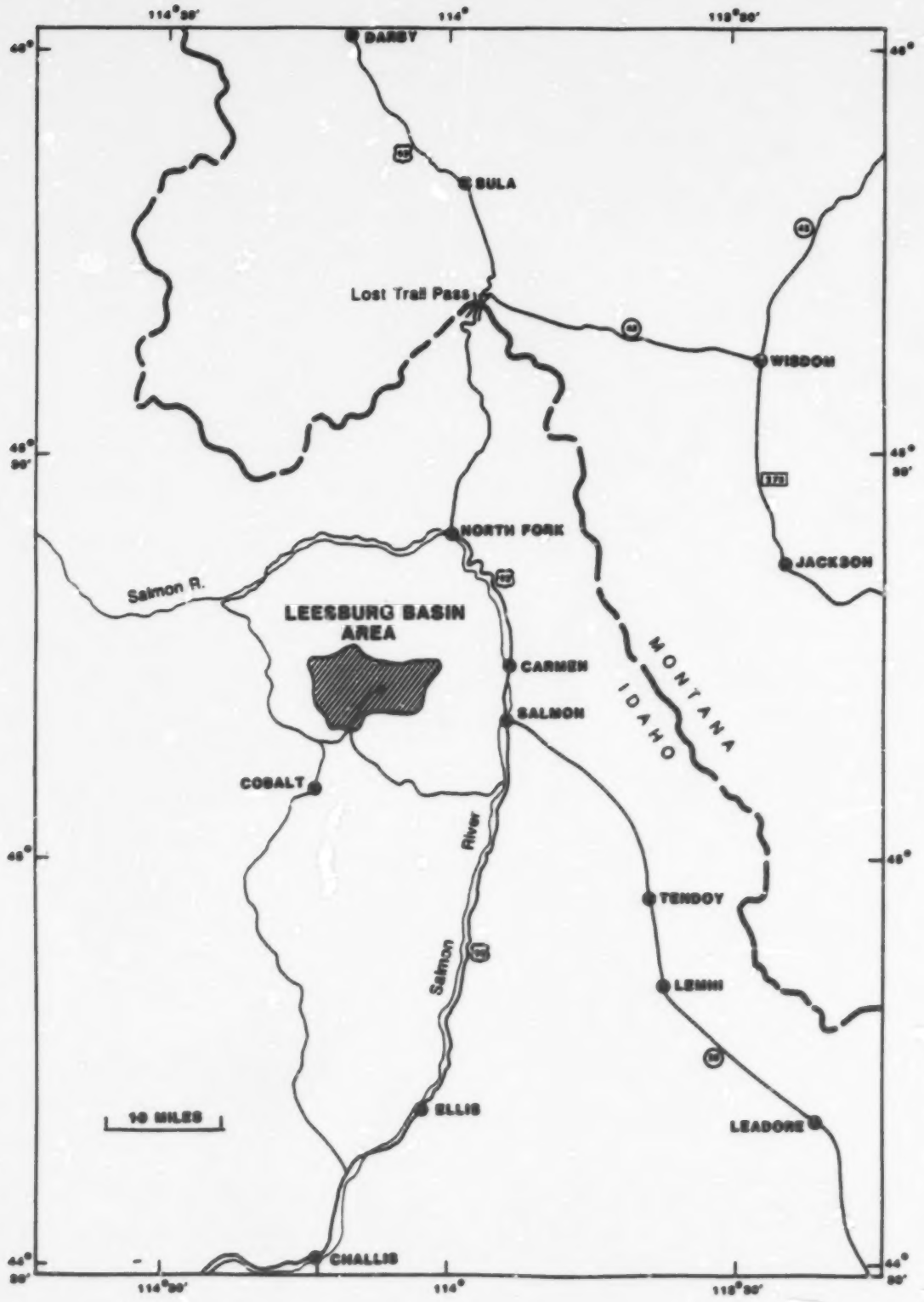

Figure 3-29—Vicinity map for the Leesburg Basin area of the Salmon National Forest in Idaho.

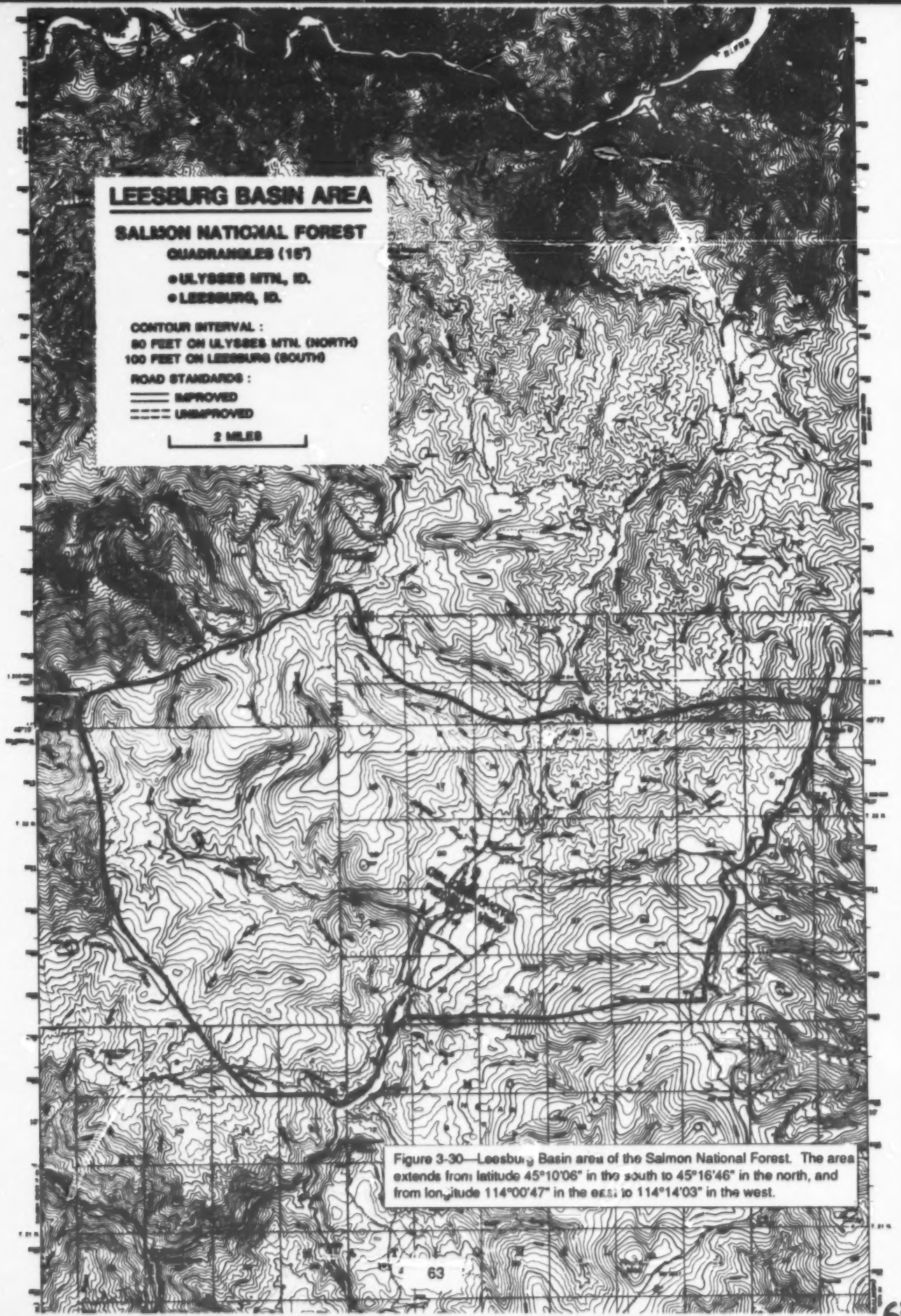

Figure 3-30—Leesburg Basin area of the Salmon National Forest. The area extends from latitude 45°10'06" in the south to 45°16'46" in the north, and from longitude 114°00'47" in the east to 114°14'03" in the west.

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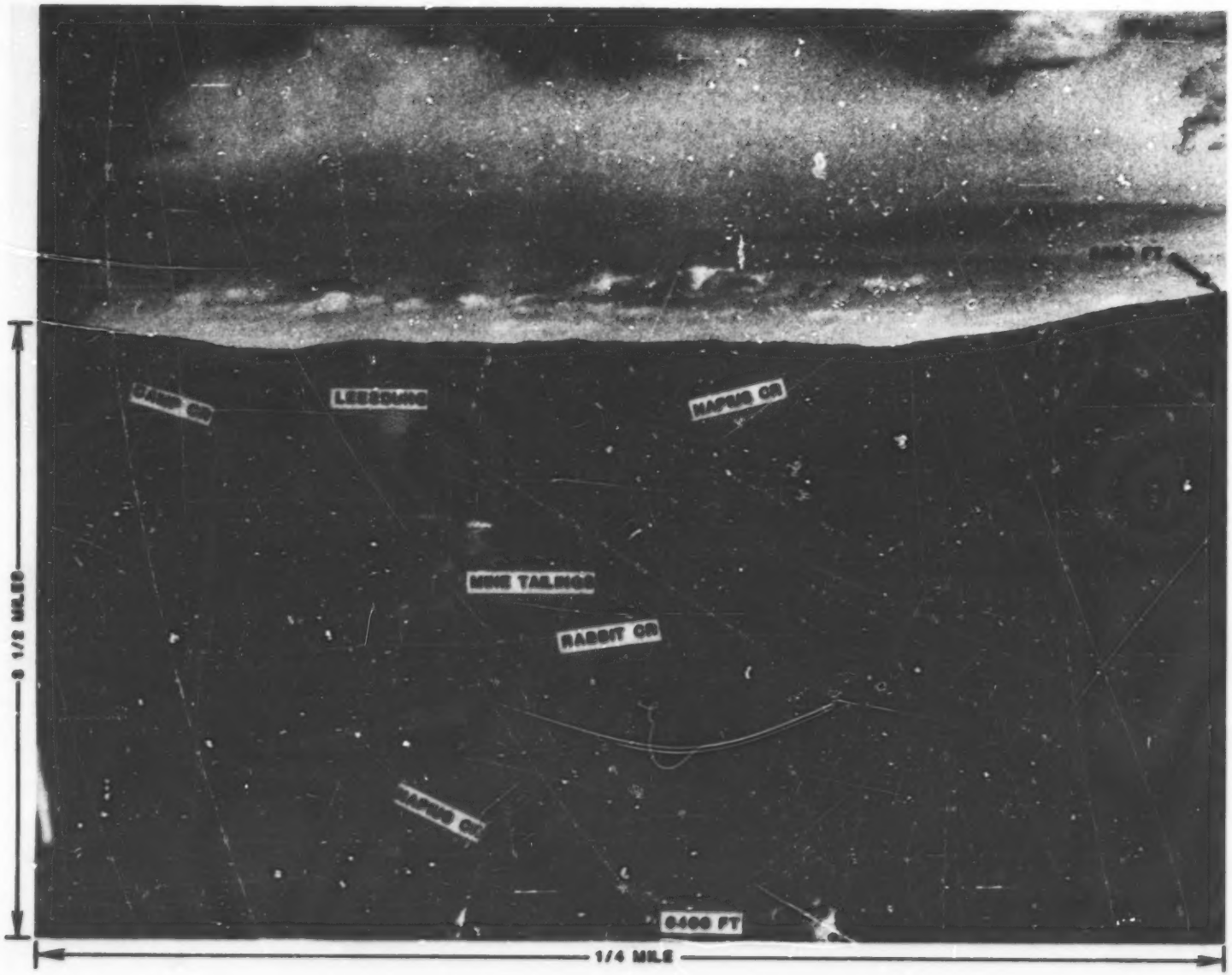

Figure 3-31—Oblique view of the Leesburg Basin area of the Salmon National Forest looking northwest up Napius Creek toward Leesburg from a point just south of the confluence of Napius Creek and Rabbit Creek; see figure 3-30 for camera viewpoint and field. Width of the foreground shown is about one-fourth mile; from the foreground to the left skyline is about 3½ miles.

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Figure 3-32—Even-aged pole stand of lodgepole pine with edge exposed by powerline right-of-way near junction of Napius Creek and Arnett Creek (6,400 feet elevation).

Figure 3-33—Uneven-aged lodgepole stand just west of Napius Creek between Arnett Creek and Jefferson Creek in the Leesburg Basin area of the Salmon National Forest. Trees are cankered and have mistletoe; larger trees are probably relicts from past bark beetle attacks.

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Figure 3-34—Cankers in lower third of stem are common in stands adjacent to Napius Creek in the Leesburg Basin area of the Salmon National Forest.

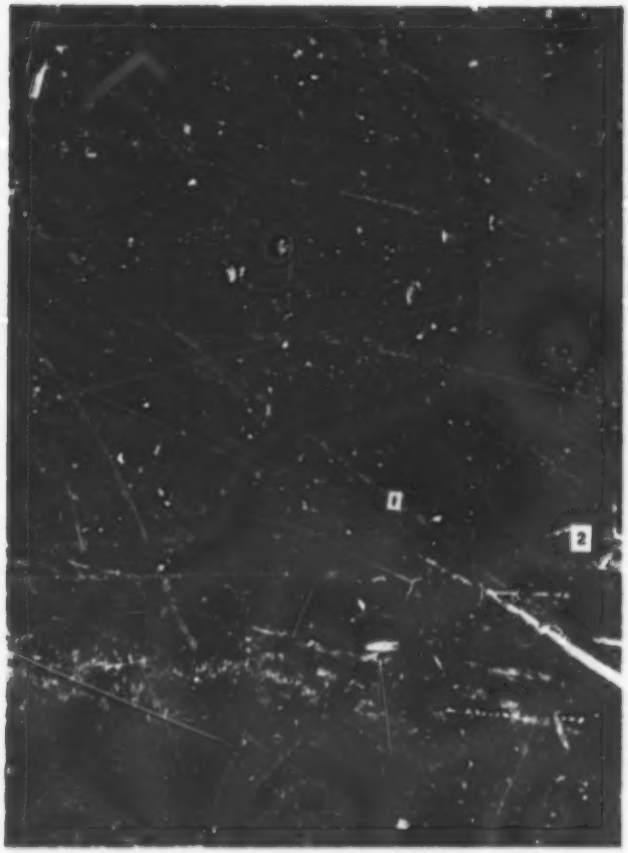

Figure 3-35—Pair of sample trees 3½ to 4 inches in d.b.h. in tall understory of uneven-aged stand at 6,500 feet near Rabbit Creek in the Leesburg Basin area of the Salmon National Forest.

Data on Sample Trees—A pair of adjacent 3½- to 4-inch trees from the tall understory were destructively sampled at 6,500 feet from an uneven-aged stand on level terrain not far from Rabbit Creek (fig. 3-35). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.26	3.38
Tree height above 6-inch high stump, feet	30.0	28.3
Crown ratio, percent	65	65
Cone serotiny	- no observation -	
Tree age years (number of annual growth rings)		
Stump height	78	46
20 percent of tree height	59	29
Base of live crown	34	26

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Characteristic	Tree number 1	Tree number
Diameter inside bark, inches		
Stump height	4.00	3.32
20 percent of tree height	2.82	3.13
Base of live crown	2.19	2.62
Height from stump top to base of crown, inches	126	120
Stem taper inside bark, inches/100 inches		
Below crown	1.44	0.58
Within crown	0.94	1.19
Rings/inch, average for section		
Stump height	37	28
Base of live crown	31	20
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry	98.6	91.6
Specific gravity, ovendry weight and green volume	0.374	0.394
Rings/inch in first 1¼ inches radius	47	18
Maximum crushing strength, lb f/in²	5,390	4,530
Proportional limit, lb f/in²	3,230	2,620
Modulus of elasticity, lb f/in²	900,000	980,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	0	0
Bark thickness (single), inch	0.09	0.14
Pith eccentricity, inch	0	0.1

Inventory Data—Inventory data for the area are incomplete, particularly in stands with trees of small diameter. As noted previously, about 25 percent of the acreage is in old-growth lodgepole pine sawtimber, about 15 percent in pole stands, and most of the balance in uneven-aged stands of low quality. Managers responsible for the area note that stands are variable, but estimate typical stand data for these three timber types as follows:

D.b.h. class	Old-growth sawtimber	Pole timber	Uneven-aged timber
Inches	*- - - Number of live stems per acre - - -*		
<2.9	1,552	695	1,010
3.0-3.9	54	792	45
4.0-4.9	71		61
5.0-5.9	57	306	76
6.0-6.9	43		78
7.0-7.9	33	94	35
8.0-8.9	29		21
9.0+	64	17	46
Total	1,903	1,904	1,372

Cubic Yield Potential and Height Growth—Estimates from 49 stands in the north portion of Leesburg Basin suggest that average potential mean annual increment in this portion of the area is about 29 ft³ per acre per year, with 95 percent of the stands yielding 16 to 42 ft³ per acre per year. In these same stands, 50-year height growth averaged 32 feet, with 95 percent of the stands having 25- to 39-foot height growth in 50 years.

The managers estimate that average potential mean annual increment for the entire area is 35 ft³ per acre per year, with 50-year height growth in managed stands of 35 feet.

Management Objectives for the Area and Constraints—Phased harvest and natural regeneration with vigorous, controlled-density stands of lodgepole pine is a major objective of the managers. Such new stands would be at less risk from mountain pine beetle attack than the present stands. Harvest activity, if it can be scheduled, will be conducted to protect and enhance wildlife habitat and visual and watershed values.

The major obstacle to accomplishment of the objective is lack of markets for low-quality and small-diameter lodgepole pine trees.

Other Lodgepole Pine Available in the Area From Public Lands—In addition to the lodgepole pine in the Leesburg Basin area, the Salmon National Forest has another 30,000 acres of similar timber adjoining to the north in the Moose Creek drainage, and a few miles to the south on Pepper Creek Ridge.

Forest Products Industry in the Vicinity—Forest industries closest to the area are those in the vicinity of Salmon, where there is a medium-size sawmill cutting Douglas-fir dimension lumber, a custom sawmill with a post-and-pole operation, a plant that manufactures laminated beams (mostly Douglas-fir), and another post-and-pole operation. Two additional mills are located in Darby, 77 miles from Salmon. All of these sawmills prefer larger logs than provided by most of the lodgepole pine forests of the area. The nearest pulpmill is near Missoula, about 150 miles from Salmon.

Population in the Vicinity—Lemhi County has a total population of 7,460 (1980); 3,514 reside in Salmon. In 1982 the average per-capita income in Lemhi County was $7,435. In 1985, 9.4 percent of the workforce was unemployed.

Ravalli County, MT, with a population of 24,800 people in 1984, has the nearest railhead town—Darby (population 581). In 1983, per-capita income in the county averaged $8,014; 10.3 percent of those in the workforce were unemployed in February 1986.

REFERENCES

Benson, Robert E.; Green, Alan W.; Van Hooser, Dwane D. 1987. Idaho's forest resources. Resour. Bull. INT-39. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 114 p.

Van Hooser, Dwane D.; Chojnacky, David C. 1983. Whole tree volume estimates for the Rocky Mountain States. Resour. Bull. INT-29. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 69 p.

CHAPTER 4: MONTANA

INTRODUCTION

In Montana, lodgepole pine predominates on about 2.9 million acres of the State's 13.6 million acres of commercial forest land, with about 8.4 billion ft³ of lodgepole pine growing stock and 18.7 billion bd ft of sawtimber (table 4-1). Approximately 33 percent of the softwood growing stock and 21 percent of the softwood sawtimber in the State is lodgepole pine (Green and others 1985).

Approximately 64 percent of the dry weight of needle-free aboveground biomass of lodgepole pine trees in Montana is in trees smaller than the 10-inch d.b.h. class (table 4-2).

The five areas selected for study by managers of public forest land in Montana (fig. 4-1) total 56,000 acres in gross area; they are individually described in the following text.

Table 4-1—Volume of lodgepole pine growing stock and sawtimber, and acreage in lodgepole pine, by ownership class, Montana[1]

Ownership class	Growing stock[2]	Sawtimber volume[3]	Commercial timberland area
	Million ft³	*Million bd ft International ¼-inch scale*	*Thousand acres*
National Forest (commercial)[4]	6,660.6	15,094.1	3,100.0
Other public	280.9	634.3	114.3
Forest industry	641.4	1,098.3	306.7
Other private	787.5	1,842.2	344.5
Total	8,370.4	18,668.9	3,865.5

[1]Source: Green and others (1985). Information presented is based on 1980 data.

[2]**Growing stock volume** = net volume in cubic feet of live sawtimber and pole timber trees (5 inches d.b.h. and larger) from stump to a minimum 4-inch top outside bark, or to the point where the central stem breaks into limbs.

[3]**Sawtimber volume** = net volume in board feet of the sawlog portion of live sawtimber trees. Sawtimber trees are live trees of commercial species, 9 inches in d.b.h. or larger (softwood), containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect.

[4]**Commercial timberland** = forest land that is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. Areas qualifying as commercial timberland have the capability of producing in excess of 20 ft³ per acre per year of industrial wood in natural stands.

Table 4-2—Dry weight of lodgepole pine trees, by tree component and diameter class—Montana[1]

Diameter class	Bole[2]	Top[2]	Total
Inches	*-- Thousand tons, ovendry basis --*		
2	—	6,509	6,509
4	—	21,301	21,301
6	30,654	16,883	47,537
8	35,351	9,120	44,471
10	25,842	6,248	32,090
12	15,864	3,893	19,757
14	7,485	1,669	9,154
16	3,129	637	3,766
18	1,123	225	1,348
20+	795	154	949
Total	120,243	66,639	186,882

[1]Source: Van Hooser and Chojnacky (1983).

[2]**Trees 5+ inches d.b.h.:** Bole weight = ovendry weight of wood and bark from a 1-foot stump to a 4-inch top diameter, inside bark; top weight = ovendry weight of wood and bark from a 4-inch diameter to tip of tree, plus branch material down to ¼-inch diameter.

Trees less than 5 inches d.b.h: Total ovendry weight of wood and bark from a 1-foot stump to tip of tree, plus branch material down to ¼-inch diameter (tabulated under "Top").

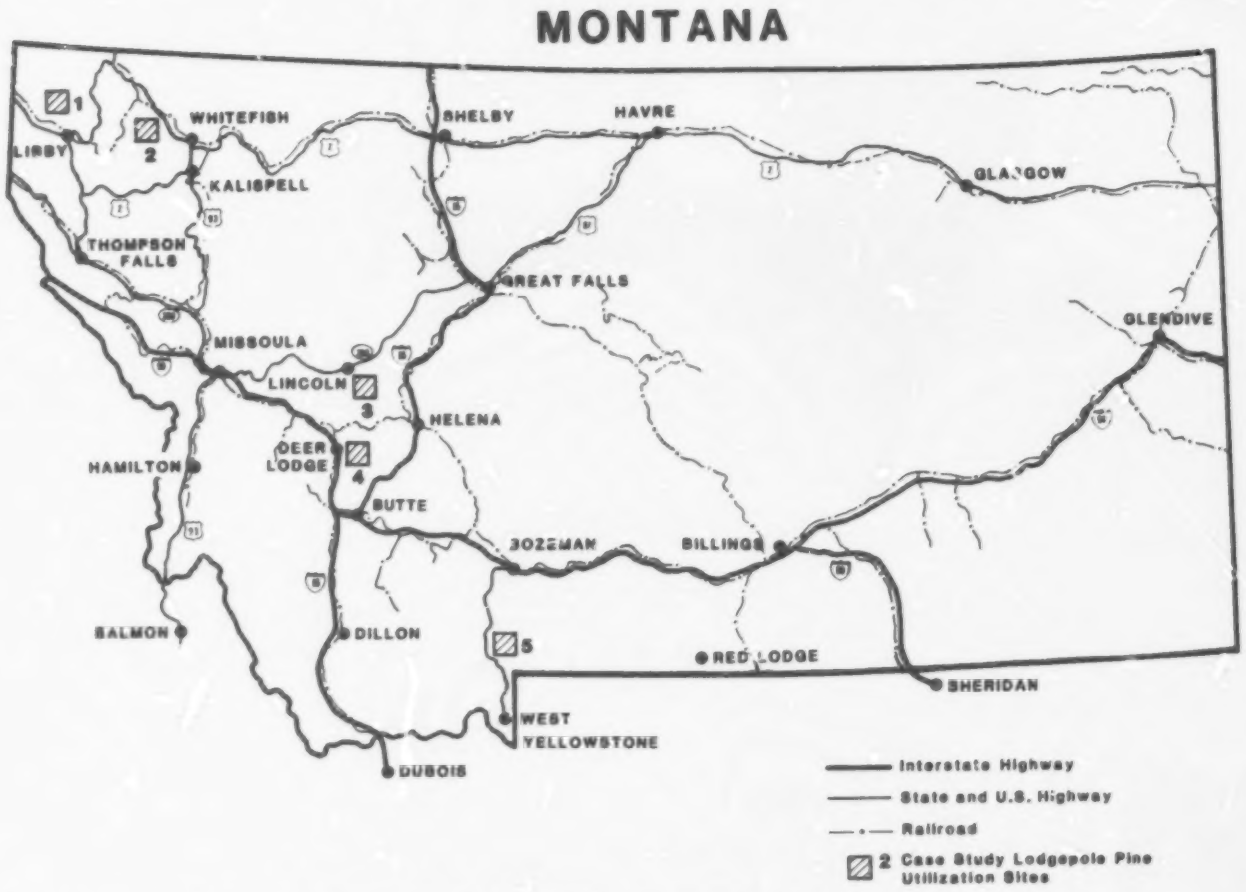

Figure 4-1—Montana location map. 1. Kootenai NF (Zulu-Smoot) 5,000 acres. 2. Flathead NF (Good Creek Burn) 17,000 acres. 3. Helena NF (Poorman Creek) 5,000 acres. 4. Deerlodge NF (Cottonwood Creek) 3,000 acres. 5. Gallatin NF (Goose-Levinski) 7,000 acres.

DEERLODGE NATIONAL FOREST

Area Name and Location—The Cottonwood Creek area (figs. 4-2, 4-3, and 4-4), which lies at an elevation of 5,500 to 7,850 feet at latitude 46°21' and longitude 112°34', is in the Deer Lodge Ranger District of the Deerlodge National Forest; the Ranger Station is in Deer Lodge.

The gross area of 3,000 acres includes about 2,400 acres of lodgepole pine timber type, and falls entirely within Powell County; Deer Lodge is the county seat. The area is centered around the Middle Fork of Cottonwood Creek just west of the Continental Divide and is 8 air miles east-southeast of Deer Lodge on a heading of 105°. From Butte, the area is 24 air miles due north.

Map of the Area—Only one USGS quadrangle 15' map (Deer Lodge, MT) is needed to depict the area.

Access—A good gravel road runs east from Deer Lodge 11 miles to where it first crosses the Middle Fork of Cottonwood Creek at the border of the central body of timber (elevation 5,600 feet). From this point one branch of the road climbs southeast to about 6,800 feet and again crosses the Middle Fork 4.1 miles upstream from the initial crossing. Another branch of the road continues south through the area and returns in a southerly loop to Deer Lodge. An unimproved dirt road reaches the border of the northern body of timber but does not penetrate it (fig. 4-3).

Deer Lodge (elevation 4,521 feet) is the nearest railhead. For highway distances from Deer Lodge to various market centers in the United States, see table 1-2.

Terrain and Soil—As noted previously, the timber lies between 5,500 and 7,850 feet, with about nine-tenths of the acreage having slopes less than 45 percent. Soils are rocky; they are of volcanic origin but have little of the ash overlay common in extreme northwestern Montana. See figures 4-5 and 4-6 for soil profiles exposed in road cuts.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals 25 to 30 inches. The snow-free season generally extends from June 1 through October.

General Character of the Timber—Within the delineated area, stands are extremely variable from pole stands (fig. 4-5) to thickets of stagnated small stems (fig. 4-6).

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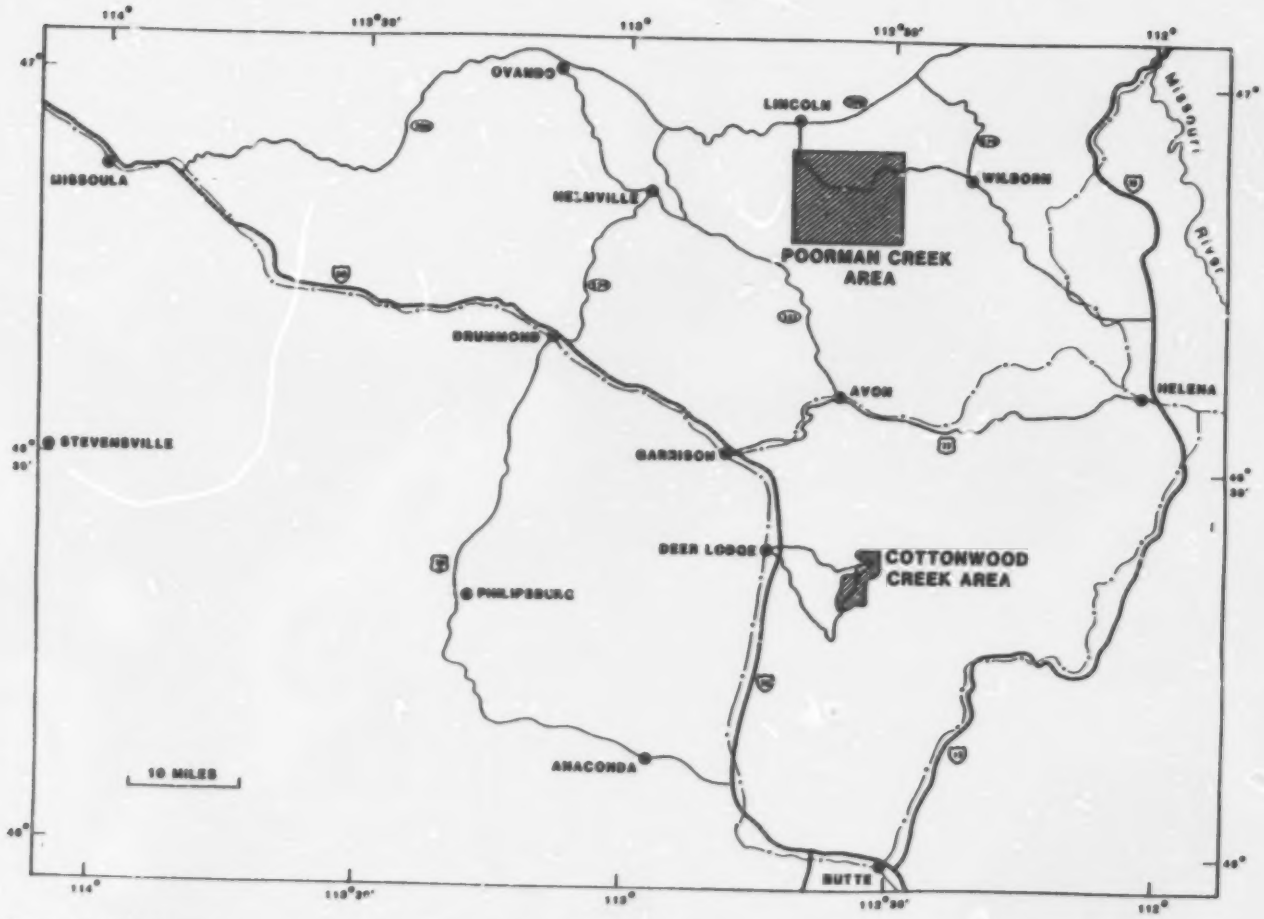

Figure 4-2—Vicinity map for the Cottonwood Creek area (Deerlodge National Forest) and the Poorman Creek area (Helena National Forest), both in Montana.

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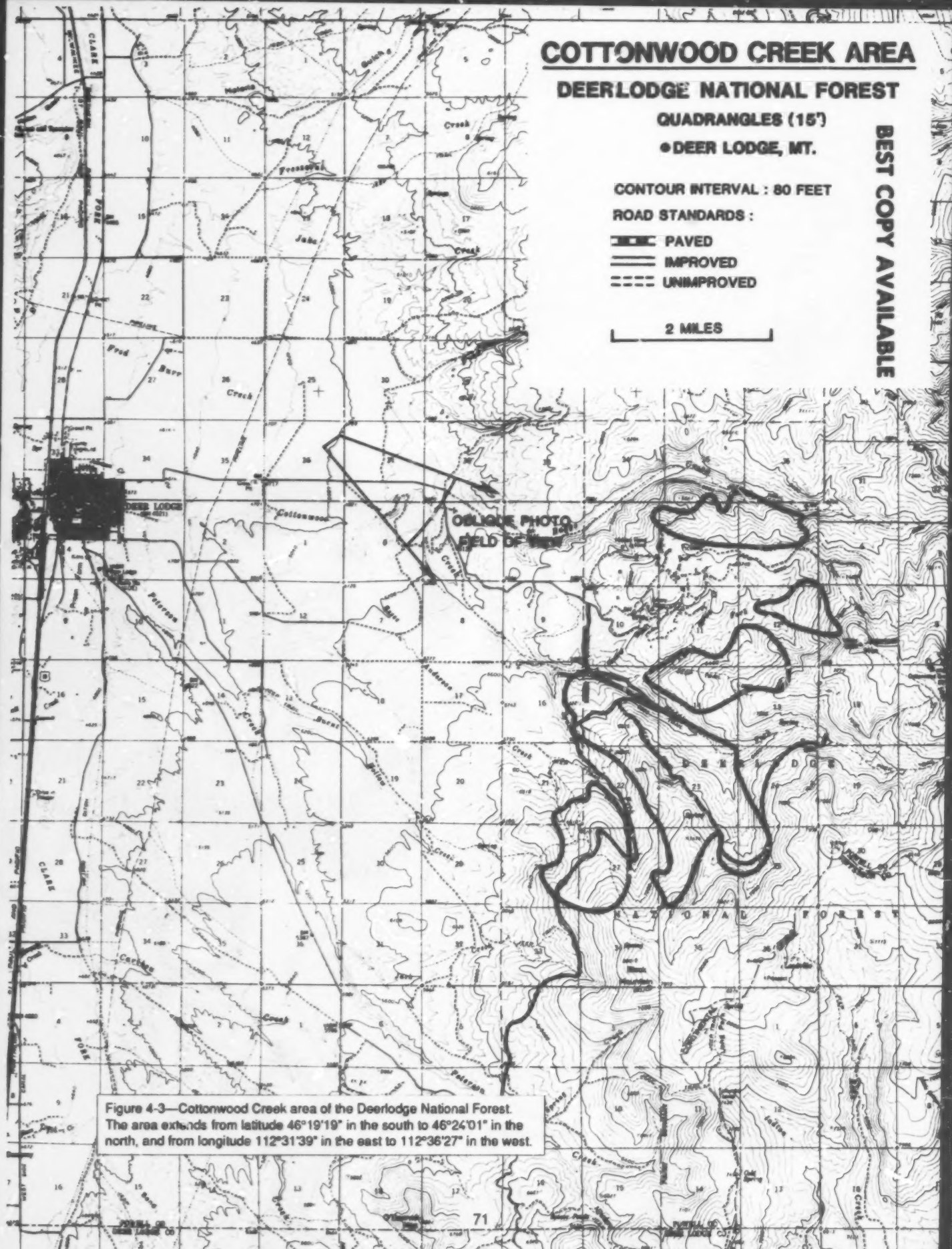

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Figure 4-3—Cottonwood Creek area of the Deerlodge National Forest. The area extends from latitude 46°19'19" in the south to 46°24'01" in the north, and from longitude 112°31'39" in the east to 112°36'27" in the west.

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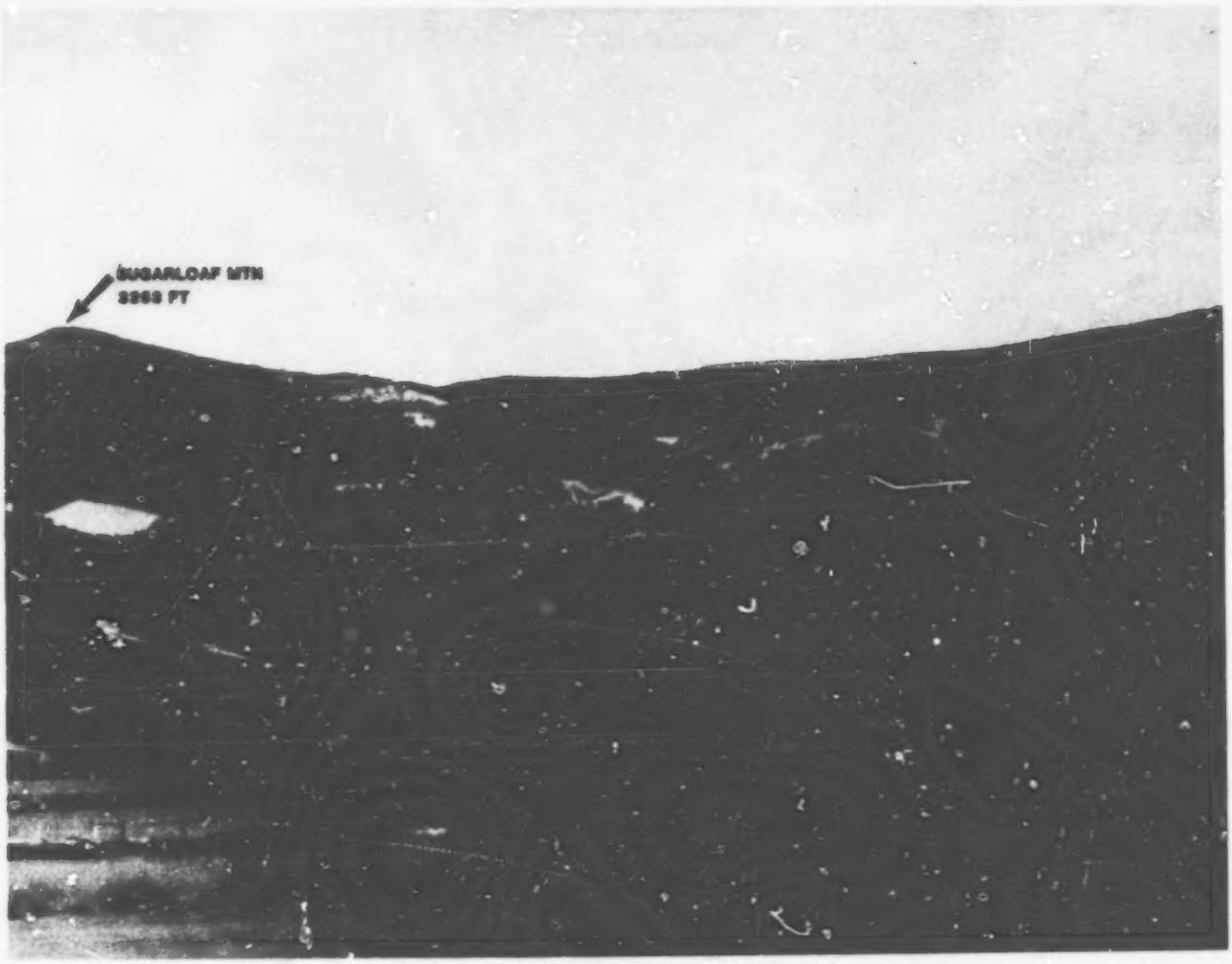

Figure 4-4—Oblique view of the Cottonwood Creek area of the Deerlodge National Forest looking southeast from near the confluence of Baggs Creek and Cottonwood Creek. See figure 4-3 for camera field of view. The distance from Cottonwood Creek in the foreground to Sugarloaf Mountain is about 12 miles. Distance along the skyline ridge is about 7 miles.

Figure 4-5—Pole stand of lodgepole looking south from the Middle Fork of Cottonwood Creek at 5,680 feet on the Deerlodge National Forest.

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Figure 4-6—Dense, stagnated stand of lodgepole pine at about 6,800 feet just south of the Middle Fork of Cottonwood Creek on the Deerlodge National Forest. The trees measure less than 3 inches in d.b.h.

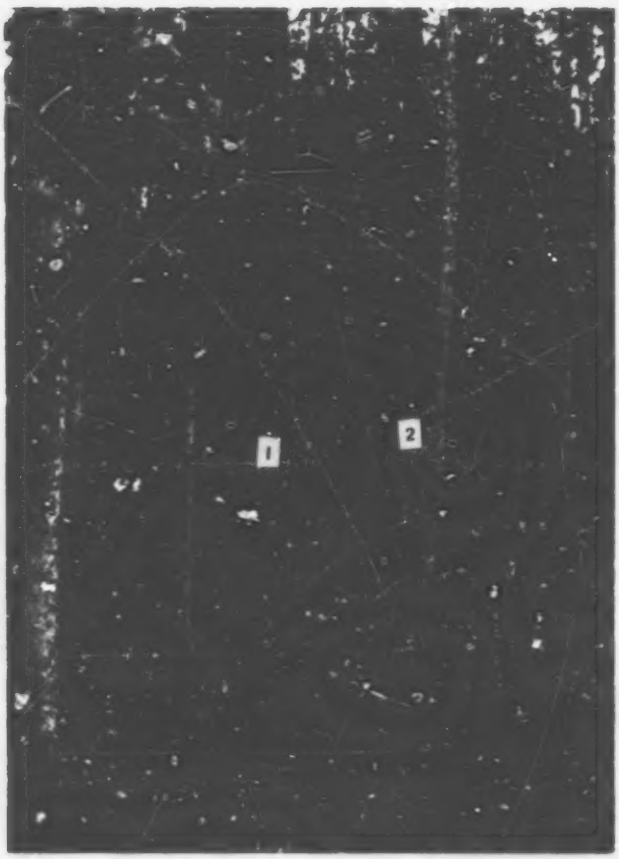

Figure 4-7—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled at 6,700 feet a little north of the Middle Fork of Cottonwood Creek on the Deerlodge National Forest. The stadia rod has 1-foot markings.

Only a small proportion of the trees are large enough to yield house logs or poles. Perhaps 600 acres of the 2,400 acres of lodgepole pine timber type are in thickets of stagnated small stems.

Trees are fairly tall and of good form, with little dwarf mistletoe infestation. Considerable porcupine damage is evident—mostly close to ground level. Mortality from mountain pine beetle attack is not evident.

Harvest activity has been limited to a few small post-and-pole operations, and no large harvests are planned.

Data on Sample Trees—A pair of adjacent codominants 3½ to 4 inches in d.b.h. were destructively sampled at an elevation of 6,700 feet slightly north of the Middle Fork of Cottonwood Creek (fig. 4-7). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties parallel to the grain at 10 percent moisture content.

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Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.95	3.95
Tree height above 6-inch high stump, feet	32.0	36.8
Crown ratio, percent	42	71
Cone serotiny	- no observation -	
Tree age years (number of annual growth rings)		
Stump height	80	80
20 percent of tree height	62	64
Base of live crown	34	63
Diameter inside bark, inches		
Stump height	4.10	3.99
20 percent of tree height	3.43	3.50
Base of live crown	2.60	3.33
Height from stump top to base of crown, inches	222	126
Stem taper inside bark, inches/100 inches		
Below crown	0.68	0.52
Within crown	1.60	1.06
Rings/inch, average for section		
Stump height	39	40
Base of live crown	26	38
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	114.1	105.4
Specific gravity, ovendry weight and green volume	0.403	0.462
Rings/inch in first 1¼ inches radius	27	35
Ultimate compressive strength, lb f/in²	6,150	6,890
Proportional limit, lb f/in²	3,500	4,160
Modulus of elasticity, lb f/in²	1,500,000	1,460,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	0	1
Bark thickness (single), inch	0.15	0.14
Pith eccentricity, inch	0.1	0.1

Inventory Data—Inventory data are incomplete for the area. As previously noted, about 25 percent of the lodgepole acreage is in stagnated thickets of small trees (typified by stand No. 12407002 of 54 acres). Most of the balance of the lodgepole acreage carries pole stands with trees 3 to 5 inches in d.b.h. predominating (typified by stand No. 12504004 of 207 acres). Data on the lodgepole live-tree component of these two stands are as follows:

D.b.h. class	Stagnated thickets		Pole stands	
Inches	*Trees/ acre*	*Feet in height*	*Trees/ acre*	*Feet in height*
1.0-2.9	2,940	16	925	23
3.0-4.9	720	25	1,100	37
5.0-6.9	277	40	268	43
7.0-8.9	11	42	37	46
9.0-13.9	9	—	9	49
Total	3,957		2,339	

Cubic Yield Potential and Height Growth—Although not well documented, managers of the area estimated that the current lodgepole pine stands are growing about 20 ft³ per acre per year; the potential is estimated at about 40 ft³ per acre per year. Fifty-year height growth in managed stands is estimated at about 40 feet, but is highly variable over the area.

Management Objectives for the Area and Constraints—A major objective of the managers is phased harvest of the area (particularly the stagnated thickets) and replacement with vigorous, controlled-density stands of lodgepole pine. Such new stands would be at less risk from mountain pine beetle, and if harvests are timed appropriately, could enhance elk and deer habitat and protect watershed and esthetic values. To this end, the managers are of the opinion that about 30 acres could be clearcut annually in the delineated area.

The major obstacle to accomplishing this objective is lack of markets for the thicket-grown and other small-diameter lodgepole.

Other Lodgepole Pine Available in the Area From Public Lands—Exclusive of timber in the Flint Range/Dolus Roadless Area, there are an additional 4,000 to 5,000 acres of similar lodgepole pine timber on the Deerlodge National Forest.

Forest Products Industry in the Vicinity—Sawmills manufacturing 2- by 4-inch studs operate in Deer Lodge, Drummond, and Hall. Post-and-pole manufacturers operate in Deer Lodge, Lincoln, Philipsburg, Hall, Drummond, Avon, and Helena; the largest operation is in Lincoln.

In the vicinity of Missoula (about 80 miles distant) there are several sawmills, a particleboard plant, and a kraft pulp mill.

Population in the Vicinity—Powell County has a total population (1984) of 6,958; of this total, 4,023 live in Deer Lodge. In 1983 the average family income in Powell County was $17,239; per-capita income in 1984 was $11,343. In 1986, 17 percent of those in the workforce were unemployed (because of diminished mining, smelting, and railroad activity).

FLATHEAD NATIONAL FOREST

Area Name and Location—The Good Creek Burn area (figs. 4-8, 4-9, and 4-10), which lies at an elevation of 3,800 to 5,800 feet at latitude 48°29' and longitude 114°43', is in the Tally Lake Ranger District of the Flathead National Forest; the Ranger Station is in Whitefish.

The gross area of about 16,000 acres is essentially all lodgepole pine timber type and falls entirely within Flathead County; Kalispell is the county seat. The area is centered around Good Creek, 19 air miles northwest from Whitefish on a heading of 285°. The east border of the area is 10 air miles due west of the north end of Whitefish Lake.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Sunday Mountain, Radnor, Dunsire Point, and Johnson Peak.

Access—An all-weather road runs southwest from Olney (which is on U.S. Highway No. 93, 18 miles north of

Whitefish) 4 miles to the northeast corner of the area, and another 10 miles through the area (along Good Creek) to the confluence of Alder Creek and Good Creek on the southwest border of the area. From the confluence, an improved gravel road runs for 3 miles north up the ridge between Alder Creek and Corduroy Creek (fig. 4-9).

The nearest railhead is at the small settlement of Olney, on the Burlington Northern rail line between Libby and Whitefish. For highway distances from Whitefish to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 3,800 and 5,800 feet elevation, with about two-thirds of the acreage having slopes less than 45 percent. Soils are glacial tills overlayed by up to 8 inches of volcanic ash (average about 4 inches); erosion potential is slight. Little exposed rock is evident and there are no special terrain obstacles.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals about 35 inches, with 3 to 4 feet of snow accumulation common in midwinter. The snow-free season generally extends from about June 1 through October.

General Character of the Timber—Almost the entire area is thickly forested with lodgepole pine. Trees along Good Creek have a fair component of trees 6 to 8 inches in d.b.h., while those at higher elevation are mostly smaller than 6½ inches in d.b.h. Dead branch retention is not excessive, and there is relatively little down timber evident in the area (figs. 4-11 and 4-12).

Damage by mountain pine beetles is beginning to appear in spots (70 percent mortality in some stands in 1986), with predictions of 50 percent overall mortality in 10 years. Stem damage from porcupines and cankers is not evident. The most recent major forest fires in the area occurred in 1926. Trees are generally less than 100 years old.

No significant harvests have been made in the past, and none are planned for the immediate future.

Data on Sample Trees—A pair of codominants 3½ to 4 inches in d.b.h. were destructively sampled from level terrain at 4,700 feet elevation between Alder Creek and Corduroy Creek (fig. 4-12). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

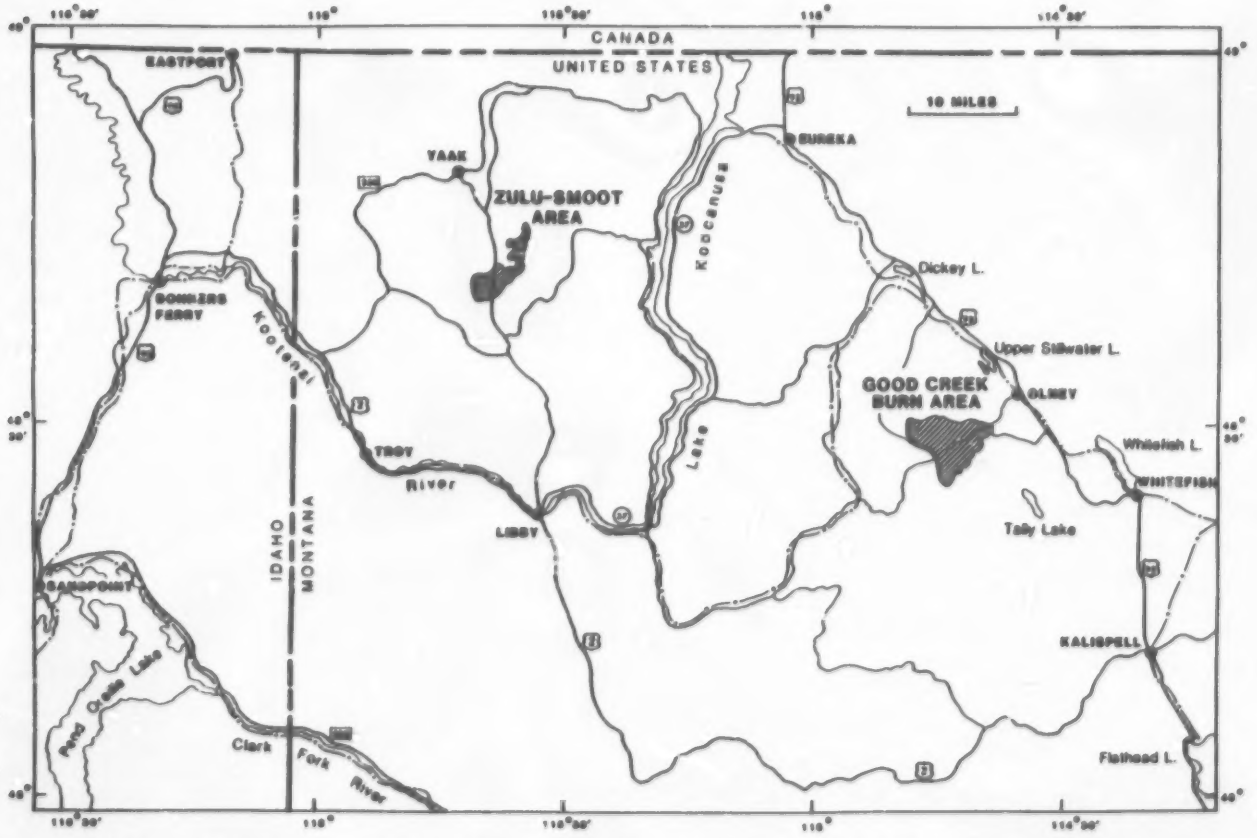

Figure 4-8—Vicinity map for the Good Creek Burn area of the Flathead National Forest and the Zulu-Smoot area of the Kootenai National Forest—both in Montana.

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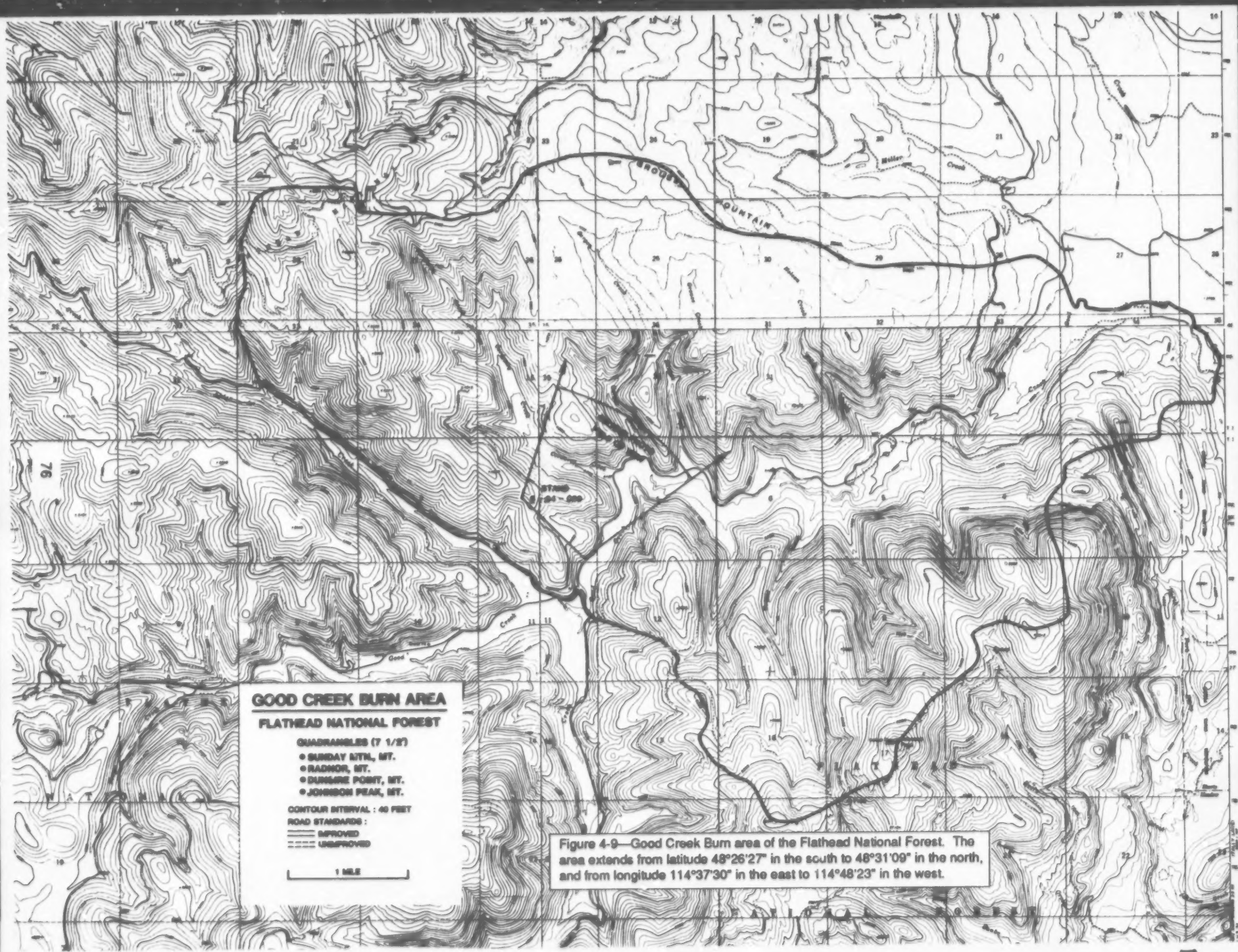

Figure 4-9—Good Creek Burn area of the Flathead National Forest. The area extends from latitude 48°26'27" in the south to 48°31'09" in the north, and from longitude 114°37'30" in the east to 114°48'23" in the west.

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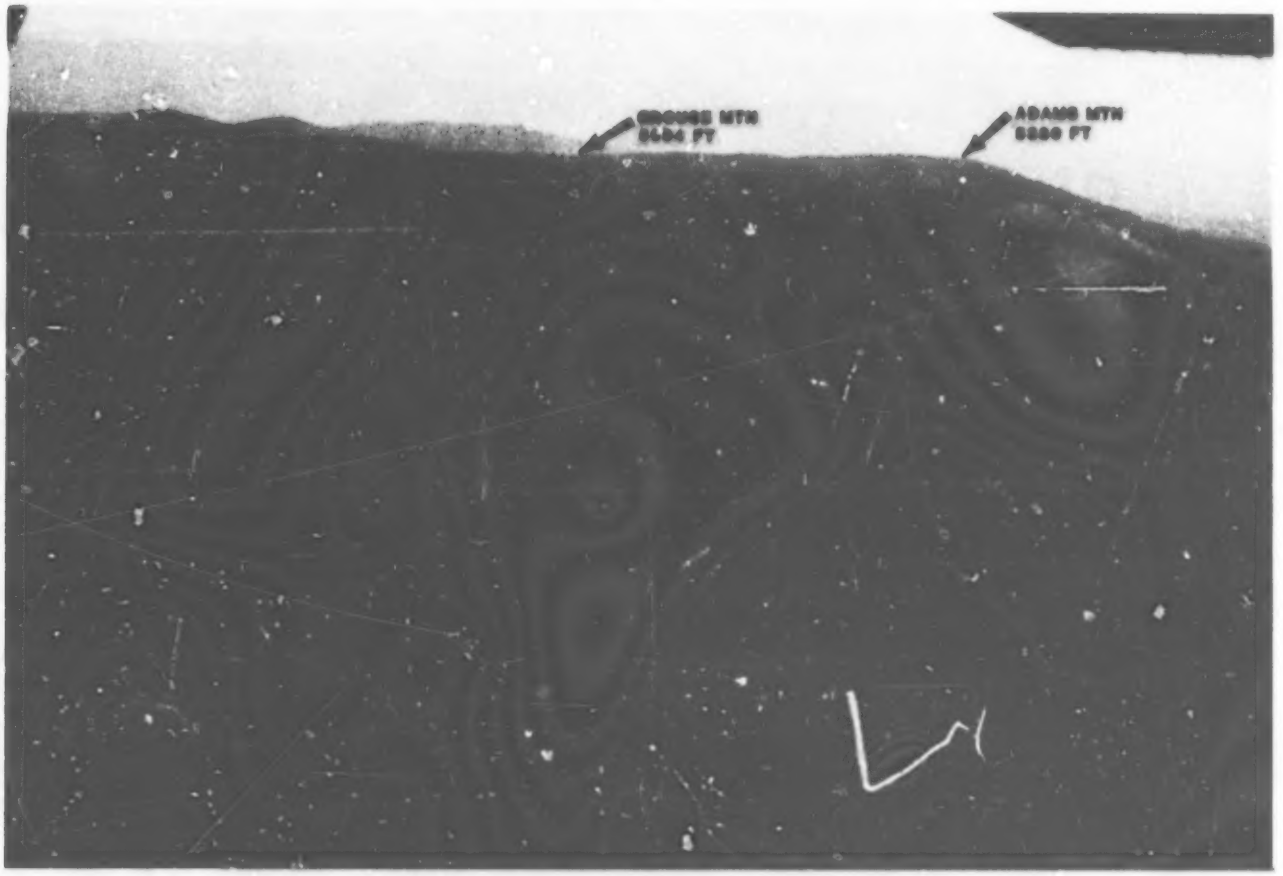

Figure 4-10—Oblique view of the Good Creek Burn area of the Flathead National Forest looking northeast from near confluence of Alder Creek and Gold Creek; see figure 4-9 for camera viewpoint and field of view. Width of foreground shown is about 1 mile; from foreground to Adams Mountain on the skyline in background is about 4 miles.

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Figure 4-11—Pole stand at 4,200 feet near the confluence of Good Creek and Alder Creek along the main access road in the Good Creek Burn area of the Flathead National Forest.

Figure 4-12—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled at 4,700 feet from level terrain between Alder Creek and Corduroy Creek in the Good Creek Burn area of the Flathead National Forest.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.57	3.80
Tree height above 6-inch high stump, feet	33.0	39.6
Crown ratio, percent	50.8	58.3
Cone serotiny	- no data taken -	
Tree age years (number of annual growth rings)		
Stump height	70	72
20 percent of tree height	49	45
Base of live crown	34	35
Diameter inside bark, inches		
Stump height	3.67	3.79
20 percent of tree height	3.10	3.43
Base of live crown	2.42	2.93
Height from stump top to base of crown, inches	195	198
Stem taper inside bark, inches/100 inches		
Below crown	0.64	
Within crown	1.20	1.06
Rings/inch, average for section		
Stump height	38	38
Base of live crown	26	24
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	82.4	78.1
Specific gravity, ovendry weight and green volume	0.479	0.406
Rings/inch in first 1¼ inches radius	25	22
Ultimate compresssive strength, lb f/in²	6,460	5,910
Proportional limit, lb f/in²	4,550	4,530
Modulus of elasticity, lb f/in²	1,370,000	1,420,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	2	1
Bark thickness (single), inch	0.15	0.10
Pith eccentricity, inch	0.2	0.1

Inventory Data—Inventory data are fairly complete for the area, and are available through the Tally Lake District office in Whitefish, MT. Most of the area carries pole stands, with trees 2 to 6 inches in d.b.h. predominating. Such stands are typified by stand 6-04-039, which is located within a few hundred yards of where the trees illustrated in figure 4-12 were sampled. Data (1981) for this 144-acre lodgepole pine stand are summarized as follows.

D.b.h. class *Inches*	Number of live trees per acre	Tree height *Feet*	Tree age *Years*
0-0.9	90	4	17
1.0-2.9	375	33	22
3.0-4.9	300	43	55
5.0-6.9	159	53	48
7.0-8.9	129	61	49
9.0-13.9	28	63	52
Total	1,081		

Additionally, the stand averaged 548 dead trees per acre.

Cubic Yield Potential and Height Growth—Managers responsible for the area estimate that it is capable of growing 75 to 100 ft³ of stemwood per acre per year in managed stands. Fifty-year height growth in managed stands is estimated to be about 50 feet.

Management Objectives for the Area and Constraints—A major management objective is phased harvest of existing stands and replacement with vigorous, controlled-density stands– not necessarily all lodgepole pine. Such new stands would be at less risk from mountain pine beetle attack than the present stands, and if harvests are timed appropriately, could enhance wildlife habitat and protect watershed and esthetic values.

The major obstacle to accomplishing this objective is lack of markets for subsawlog-size lodgepole pine.

Other Lodgepole Pine Available in the Area From Public Lands—It is estimated that an additional 10,000 acres of similar lodgepole pine stands are encompassed within the Flathead National Forest within a 50-air-mile radius of Kalispell.

Forest Products Industry in the Vicinity—At Olney, a large sawmill manufactures 2- by 4-inch studs and 1 by 3's and 4's from tree-length lodgepole pine with top diameters as small as 4 inches. Another large stud mill is located southeast of Eureka along U.S. Highway No. 93. A sawmill that manufactures random-length dimension lumber from a variety of species is located at Eureka, and another by Upper Stillwater Lake. Columbia Falls, a few miles east of Whitefish, is a major center for forest products manufacturing. Also, a post-and-pole plant operates in Kalispell, 13 miles south of Whitefish. The nearest pulp mill is near Missoula, about 120 highway miles south of Whitefish.

Population in the Vicinity—In 1984 Flathead County had a total population of 53,900, with 11,000 residing within the town limits of Kalispell, the county seat (26,000 in greater Kalispell). In 1980 Whitefish had a population of 3,749 within urban city limits, and about 7,000 in greater Whitefish.

Per-capita income in Flathead County averaged $10,874 in 1984; 11.0 percent of the workforce was unemployed in February 1986.

GALLATIN NATIONAL FOREST

Area Name and Location—The Goose-Levinski area (figs. 4-13, 4-14, and 4-15), which lies at an elevation of 5,800 to 9,800 feet at latitude 45°16' and longitude 111°12', is in the Bozeman Ranger District of the Gallatin National Forest; the Ranger Station is in Bozeman.

The gross area of about 7,000 acres includes about 5,000 acres of lodgepole pine timber type and falls entirely within Gallatin County; Bozeman is the county seat. The area is centered on Goose and Levinski Creeks immediately southeast of the Gallatin River (adjoining the river), and is due east across the main Gallatin River from its confluence with the West Fork. From Bozeman the area is 30 air miles south-southwest on a heading of 200°.

Maps of the Area—USGS quadrangle 15' maps needed to depict the area are: Spanish Peaks, MT; Garnet Mountain, MT; Sphinx Mountain, MT; and Crown Butte, MT-WY.

Access—U.S. Highway No. 191 runs 37 miles south-southwest to the confluence of Portal Creek with the Gallatin River, and another 6 miles along the area's northwest boundary to the Gallatin River confluence with the West Fork on the westernmost edge of the area. A good gravel road extends up Portal Creek a few miles and then an unimproved dirt road (10 miles from the Portal Creek-Gallatin River confluence) reaches 7,500 feet elevation on the divide between Hidden Creek and Portal Creek; from whence the dirt road leads to Hidden Creek and west to the area boundary at about 8,200 feet (fig. 4-14). Narrow strips of private land just southeast of the Gallatin River lie between U.S. Highway No. 191 and much of the area's northwest boundary.

The nearest railhead is Bozeman, or equally distant Belgrade, both on the Burlington Northern line (fig. 4-13). For highway distances from Bozeman to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 5,800 and 9,800 feet elevation, but most of the timber lies below 8,000 feet. Most of the timbered acreage has slopes in excess of 45 percent. Soils are moderately coarse in texture with significant rock outcroppings (up to 40 percent). These outcroppings, together with the steep slopes, are the major physical obstacles to harvesting.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals 30 to 50 inches, with 2 or 3 feet of snow accumulation common in winter. The snow-free season generally extends from June 1 through October.

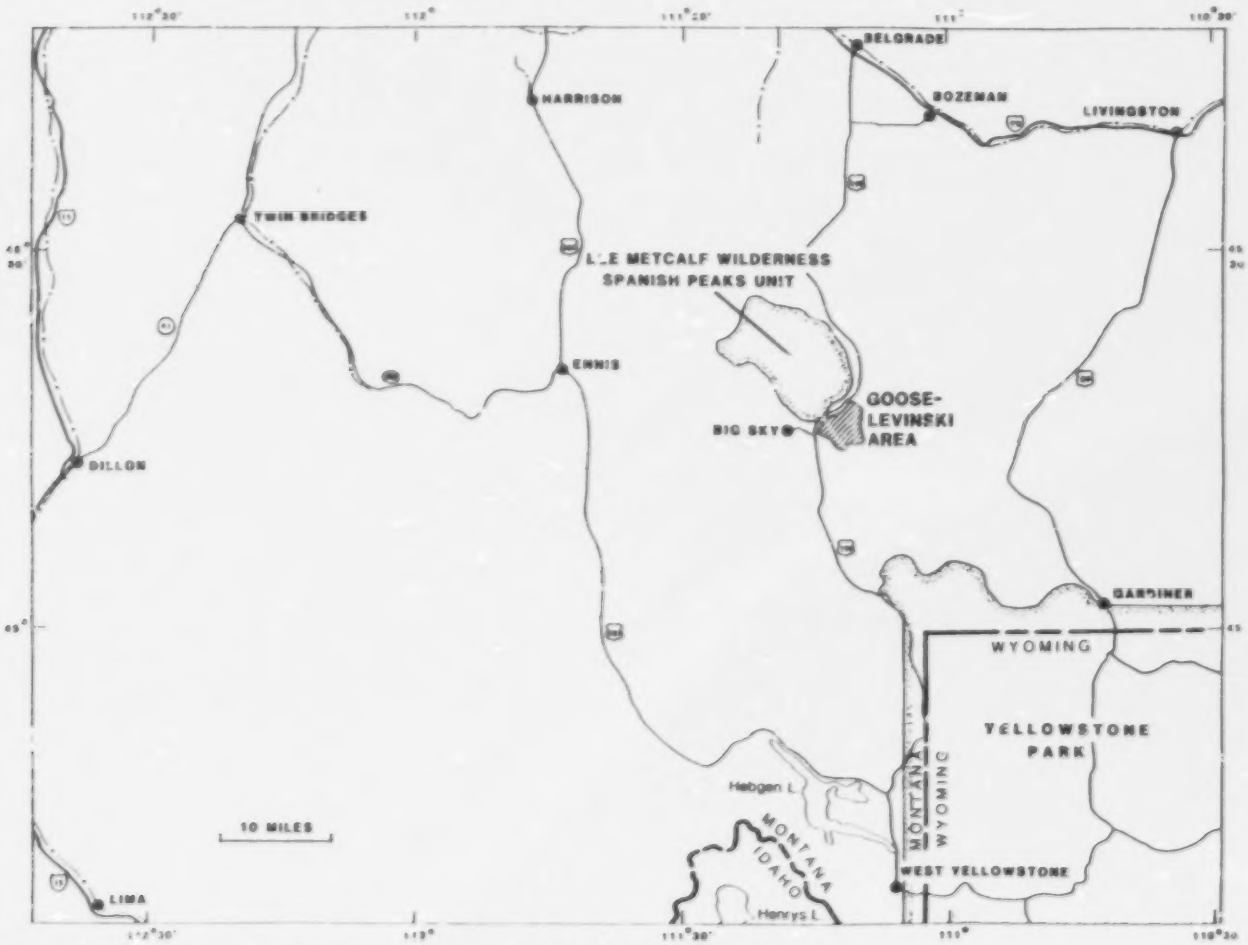

Figure 4-13—Vicinity map for the Goose-Levinski area of the Gallatin National Forest in Montana.

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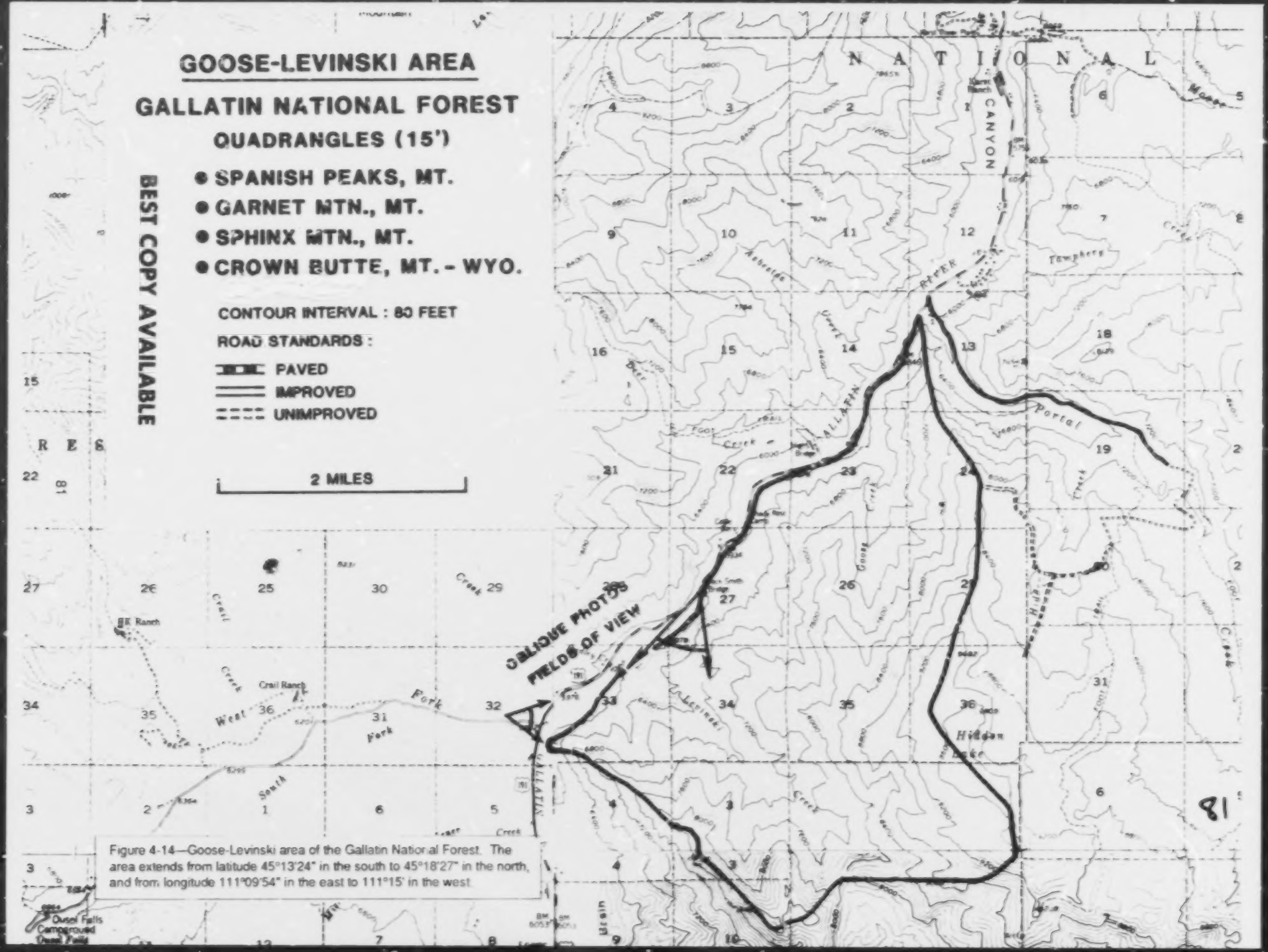

Figure 4-14—Goose-Levinski area of the Gallatin National Forest. The area extends from latitude 45°13'24" in the south to 45°18'27" in the north, and from longitude 111°09'54" in the east to 111°15' in the west.

General Character of the Timber—The lodgepole pine trees are predominantly 1 to 7 inches in d.b.h. (table 4-3). Although a significant proportion of the trees (up to 50 percent) are dead from mountain pine beetle attack, there is not yet excessive down timber. Also, significant numbers of trees have cankers on lower stem sections (fig. 4-16).

The last major forest fires in the area were in the 1880's. There has been virtually no harvesting in the area, and none is planned in the immediate future.

Data on Sample Trees—A pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. were destructively sampled just south of Levinski Creek at 6,400 feet elevation (fig. 4-17). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.80	3.55
Tree height above 6-inch high stump, feet	45.0	36.0
Crown ratio, percent	49	26
Cone serotiny	- - no data taken - -	
Tree age years (number of annual growth rings)		
Stump height	96	89
20 percent of tree height	46	67
Base of live crown	37	39
Diameter inside bark, inches		
Stump height	3.82	3.68
20 percent of tree height	3.37	3.18
Base of live crown	2.20	2.17
Height from stump top to base of live crown, inches	276	318
Stem taper inside bark, inches/100 inches		
Below crown	0.59	0.47
Within crown	0.83	1.90
Rings/inch, average for section		
Stump height	52	47
Base of live crown	32	36
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	80.0	82.2
Specific gravity, ovendry weight and green volume	0.456	0.471
Rings/inch in first 1¼ inches radius	37	40
Ultimate compresssive strength, lb f/in²	7,900	8,700
Proportional limit, lb f/in²	6,080	5,220
Modulus of elasticity, lb f/in²	1,570,000	1,800,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	2	2
Ring width, inches		
Stump height	0.12	0.12
20 percent of tree height	0.1	0.2

Inventory Data—Stand examination data are available at the Bozeman Ranger District office for most of the area below 8,000 feet. Data summarized from several of the lodgepole pine stands having acreage in excess of 80 acres (table 4-3) suggest that stands may typically have 1,100 or 1,200 trees per acre larger than 1.0 inch in d.b.h., and that a little more than half these trees measure 1.0 to 2.9 inches in d.b.h., about one-third 3.0 to 4.9 inches, one-tenth 5.0 to 6.9 inches, and less than one-tenth larger than 7 inches in d.b.h.

Cubic Yield Potential and Height Growth—Managers responsible for the area estimate that present growth of stemwood in the area is about 25 ft³ per acre per year. Fifty-year height growth in managed stands is estimated at 55 to 60 feet.

Management Objectives for the Area and Constraints—Because the site is relatively good for lodgepole pine, and because the risk of mortality from fire and mountain pine beetle is high, managers of the area would like to see a phased replacement of decadent stands with vigorous, new, controlled-density lodgepole stands. But small stem size, very steep and rocky terrain, difficult access, high proportion of dead volume, and high visibility of the area from the Gallatin River corridor leading to Yellowstone Park, make it improbable that any harvest other than small-scale experimental harvests for research purposes will be conducted in the area in the foreseeable future.

Other Lodgepole Pine Available in the Area From Public Lands—Managers of the Gallatin National Forest believe that milling capacity in the area now exceeds scheduled yield from the forest, so additional acreage is probably not available for additional mills—even those designed to utilize trees of subsawlog diameters.

Forest Products Industry in the Vicinity—In the extended vicinity there are two large mills manufacturing 2- by 4-inch studs—one in Belgrade and one in Livingston. Additionally, sawmills that manufacture random-length dimension lumber are located in Livingston and a few miles southwest of Bozeman. Lodgepole pine roundwood manufacturers include post-and-pole operations in Belgrade and Bozeman, and three manufacturers of house logs southwest of Bozeman.

Population in the Vicinity—Gallatin County has a total population (1986) of 46,183; the population of the town of Bozeman is 25,050. Per-capita income in Gallatin County averaged $8,737 in 1982. In 1986, 6.9 percent of the workforce in Gallatin County was unemployed.

HELENA NATIONAL FOREST

Area Name and Location—The Poorman Creek area (figs. 4-2, 4-18, and 4-19), which lies at an elevation of 4,600 to 7,600 feet at latitude 46°52' and longitude 112°34', is in the Lincoln Ranger District of the Helena National Forest; the Ranger Station is in Lincoln.

Table 4-3—Stand table data for five lodgepole pine stands 81 acres or larger in the Goose-Levinski area of the Gallatin National Forest; live trees only larger than 1 inch. The letter "S" behind the number of trees per acre denotes spruce rather than lodgepole pine

D.b.h. class, inches, and statistic	Stand number (and acres)				
	01012 (139)	01018 (84)	02002 (86)	02010 (127)	03059 (81)
1.0-2.9					
Number of trees/acre	325	75	935	880	225
Tree height, feet	25	20	25	30	14
3.0-4.9					
Number of trees/acre	525	325	525	400	75
Tree height, feet	38	32	38	41	37
5.0-6.9					
Number of trees/acre	123	93	123	206	16
Tree height, feet	43	40	43	51	50
7.0-8.9					
Number of trees/acre	40	74	40	62	38
Tree height, feet	63	49	63	57	55
9.0-13.9					
Number of trees/acre	40S	0	20S	8S	21
Tree height, feet	75	—	75	71	65

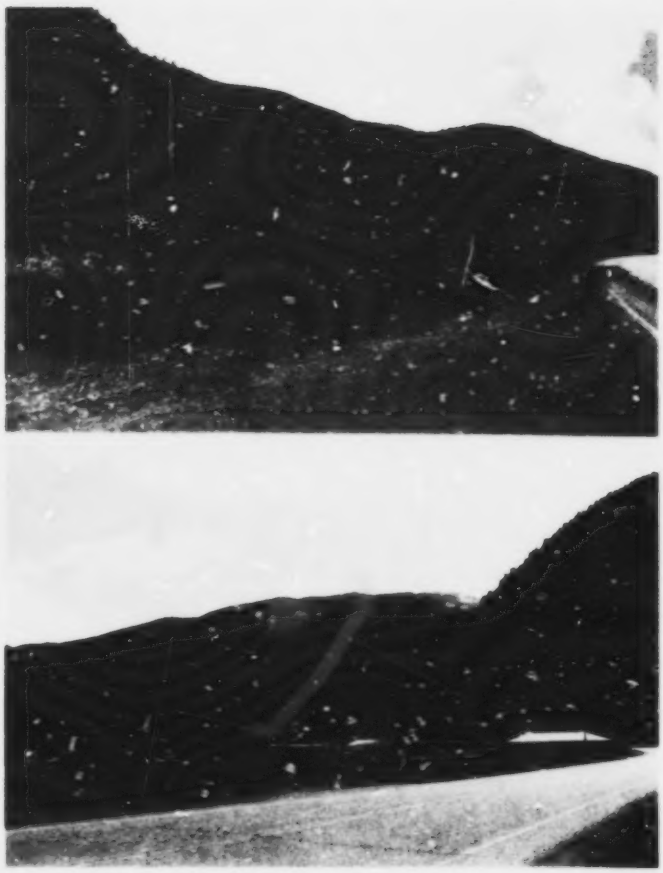

Figure 4-15—Goose-Levinski area of the Gallatin National Forest viewed from near the Jack Smith Bridge on U.S. Highway No. 191 (top), and from near the highway junction to Big Sky resort (bottom). See figure 4-14 for photo viewpoints.

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Figure 4-16—Lodgepole pines on southwest-facing slope at 6,400 feet just south of Levinski Creek in the Gallatin National Forest. Cankers are visible on lower stems of foreground trees at right and left. About half the trees have been bark beetle killed.

Figure 4-17—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled just south of Levinski Creek at 6,400 feet elevation.

The gross area of 25,000 acres includes about 8,300 acres of lodgepole pine timber stands and falls mostly within Lewis and Clark County (fig. 4-18); Helena is the county seat. The southeast corner of the area extends into Powell County, of which Deer Lodge is the county seat.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Finn, Granite Butte, Lincoln, Nevada Mountain, Stemple Pass, and Swede Gulch.

Access—The more-or-less rectangular area lies immediately west of the Continental Divide. Accessibility to the bottoms of some of the major drainages is complicated by the presence of mining claims (fig. 4-18).

An all-weather gravel road runs from Lincoln (elevation about 4,500 feet) south about 3 miles to the north border of the area, and then east up Poorman Creek (which bisects the area) to Stemple Pass, which is 16 highway miles distant from Lincoln at an elevation of 6,200 feet on the Continental Divide (fig. 4-18). A dirt loop road runs south from Stemple Pass and then down the South Fork of Poorman Creek. Additional dirt roads extend short distances into the northern half of the area.

The all-weather road extends 42 miles southwest beyond Stemple Pass to the railhead town of Helena (elevation about 3,800 feet). Slightly more distant to the south and southwest are the railheads at Avon, Garrison, and Drummond (fig. 4-2). For highway distances from Helena to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 4,600 and 7,600 feet elevation, with about half of the area having slopes in excess of 45 percent (fig. 4-19). Soils are not excessively stony, and they present no special obstacles to road building. Grassy openings in the timber are features of that portion of the area north of Poorman Creek.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals about 20 inches, most of which falls as snow. The snow-free season generally extends from early June through late October.

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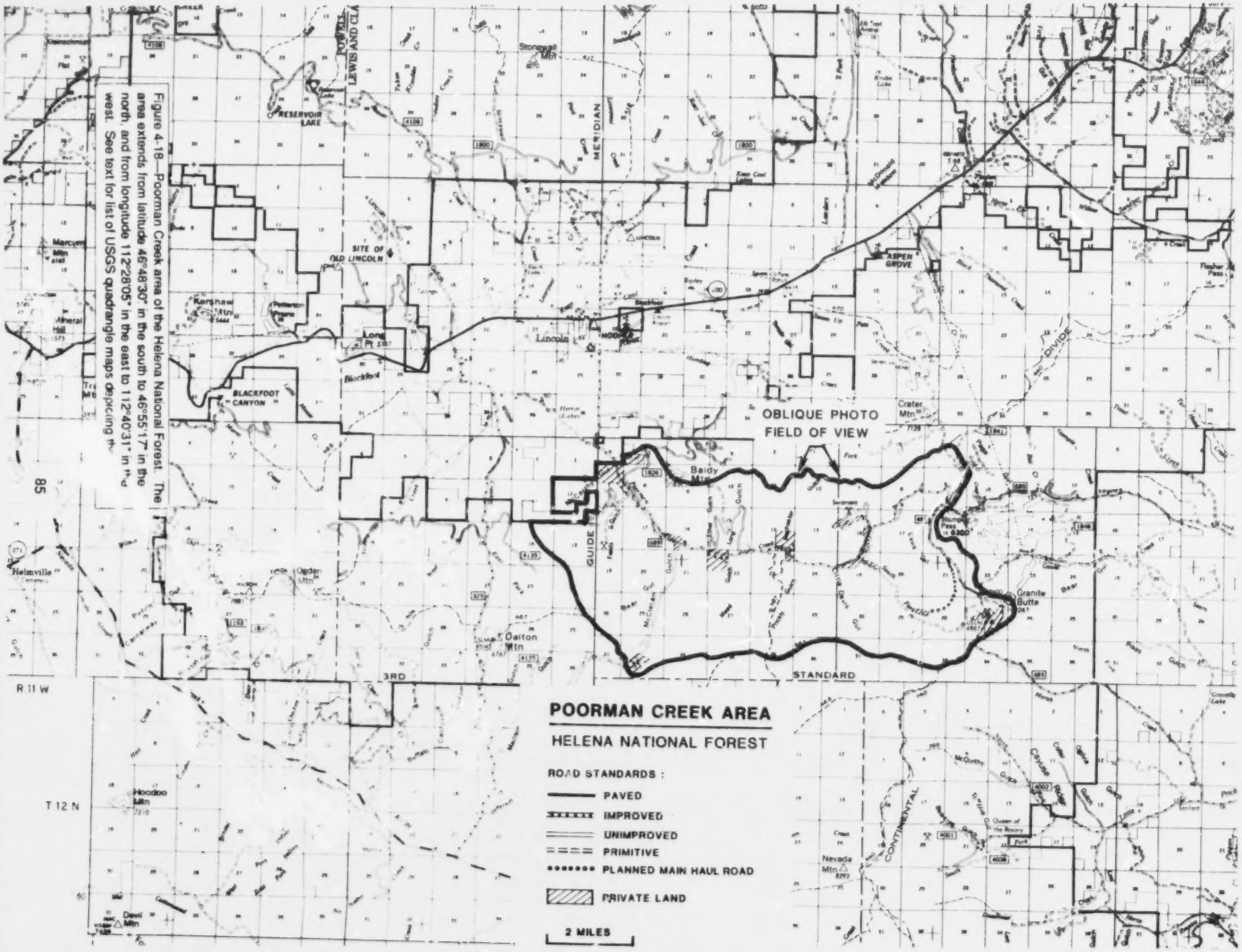

Figure 4-18—Poorman Creek area of the Helena National Forest. The area extends from latitude 46°48'30" in the south to 46°55'17" in the north, and from longitude 112°28'05" in the east to 112°40'31" in the west. See text for list of USGS quadrangle maps depicting the

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Figure 4-19—Oblique view of the Poorman Creek area of the Helena National Forest looking west from the head of Rochester Gulch; see figure 4-18 for camera viewpoint and field. The area illustrated is about 4 miles across, and 5 miles from foreground to low background. About 90 percent of the area is timbered.

General Character of the Timber—The timbered area is virtually all lodgepole pine type, but has a significant Douglas-fir component. Stands grade in a continuum from small pole stands (fig. 4-20) into dense thickets of very small stagnated stems (fig. 4-21), and into small sawtimber.

The small sawtimber may have red heart fungal infections in the heartwood. Stem crook, stem cankers, and porcupine damage are all evident in many of the pole stands (fig. 4-22). Mortality from mountain pine beetle is not evident, and the forest floor is comparatively clear of down timber. Most of the stands have moderate to heavy dwarf mistletoe infestations.

Most of the acreage was burned during the peak of mining activity from 1860 to 1900. In recent years there has been little harvest activity, but significant harvests are planned for the next decade.

Data on Sample Trees—A pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. were destructively sampled just south of Stemple Pass from gently sloping ground at 6,200 feet elevation (fig. 4-20). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

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Figure 4-20—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled from gently sloping terrain just south of Stemple Pass at an elevation of about 6,200 feet.

Figure 4-21—Densely stocked, stagnated stand of lodgepole pines—almost all less than 3 inches in d.b.h.—in the Poorman Creek area of the Helena National Forest. The stadia rod in the center of the photo has 1-foot markings.

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Figure 4-22—Typical defects of lodgepole pines observed in the Poorman Creek area of the Helena National Forest. (Top) Porcupine damage at butt of stem. (Bottom left) Stem crook; the stadia rod has 1-foot markings. (Bottom right) Stem cankers.

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Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.70	4.0
Tree height above 6-inch high stump, feet	28.0	34.8
Crown ratio, percent	38.1	25.4
Cone serotiny	no observation	
Tree age years (number of annual growth rings)		
Stump height	98	93
20 percent of tree height	74	76
Base of live crown	56	33
Diameter inside bark, inches		
Stump height	3.80	4.25
20 percent of tree height	3.18	3.55
Base of live crown	2.38	2.05
Height from stump top to base of crown, inches	208	312
Stem taper inside bark, inches/100 inches		
Below crown	0.68	0.71
Within crown	1.86	1.93
Rings/inch, average for section		
Stump height	52	44
Base of live crown	47	32
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	95.9	103.4
Specific gravity, ovendry weight and green volume	0.432	0.423
Rings/inch in first 1¼ inches radius	42	32
Maximum crushing strength, lb f/in²	5,990	7,240
Proportional limit, lb f/in²	4,590	5,300
Modulus of elasticity, lb f/in²	1,350,000	1,860,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	0	1
Bark thickness (single), inch	0.11	0.14
Pith eccentricity, inch	0.2	0.5

Inventory Data—The entire area has been type mapped, and the lodgepole timber stands classified as type 1 (22 percent of the 8,300 acres of lodgepole pine), type 2 (72 percent of the 8,300 acres), and type 3 (6 percent of the 8,300 acres), with accompanying inventories based on 35, 40, and 25 plots, respectively (table 4-4). Type 1 is predominantly sapling size trees, often in overstocked "doghair" stands; type 2 is small to medium pole size class material; and type 3 is large pole and small sawtimber size class. Live lodgepole stems larger than 2.9 inches in d.b.h. numbered 1,375, 930, and 396 stems per acre for stand types 1, 2, and 3, respectively.

In addition to the live lodgepole stems enumerated in table 4-4, the three types of stands had other stems larger than 2.9 inches in d.b.h. as follows:

Table 4-4—Diameter and height distribution of live trees for three major stand types of lodgepole pine in the Poorman Creek area of the Helena National Forest[1]

D.b.h. class, inches, and statistics	Stand type 1	Stand type 2	Stand type 3
0-2.9			
Number of trees/acre	3,109	915	40
Tree height, feet	—	—	—
3.0-3.9			
Number of trees/acre	706	320	20
Tree height, feet	33.6	33.7	24.2
4.0-4.9			
Number of trees/acre	383	202	32
Tree height, feet	40.0	41.5	38.3
5.0-5.9			
Number of trees/acre	169	123	36
Tree height, feet	43.7	49.5	41.7
6.0-6.9			
Number of trees/acre	91	115	104
Tree height, feet	48.9	50.9	44.3
7.0+			
Number of trees/acre	26	170	204
Tree height, feet	48.9	60.6	49.4
Total live trees/acre	4,484	1,845	436

[1] **Stand type 1** = lodgepole pine saplings. Preponderance of stems smaller than 3 inches d.b.h. with limited representation of stems 5 inches and larger. **Stand type 2** = lodgepole pine poles. Approximately half the stems smaller than 3 inches d.b.h. with substantial representation of stems in the 4-, 5-, and 6-inch classes. **Stand type 3** = lodgepole pine poles. Few stems smaller than 4 inches d.b.h. with major representation of stems in the 6- and 7-inch classes.

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Stand type	Dead lodgepole	Other species
	- - - Trees per acre - - -	
1	49	15
2	71	90
3	44	84

Although table 4-4 and the foregoing percentages of each of the three types tabulated are sufficient to convey a general idea of the inventory, a more detailed report has been prepared for the Intermountain Research Station (Hawkins 1987). The detailed report contains information for each stand type on percent slope, aspect, diameter at the base of the crown, rings per inch, cubic feet of stem volume per acre, dead-tree statistics, associated species, and prevalence and kind of defect.

Cubic Yield Potential and Height Growth—Although data are not well documented, managers of the area estimate that growth potential for managed lodgepole pine stands is 70 to 80 ft^3 per acre per year. Fifty-year height growth in managed stands is estimated at 50 feet.

Management Objectives for the Area and Constraints—Much of the area is visible from the Continental Divide Trail; harvest activities in the area, therefore, must not excessively disrupt visual quality of landscapes in view of the trail. The area is also good elk habitat—a value that must be enhanced. Also, watershed value must be preserved.

With the foregoing qualifications, the managers of the area would like to accomplish a phased replacement of the present stagnated stands with vigorous, new, controlled-density lodgepole stands.

Other Lodgepole Pine Available in the Area From Public Lands—In addition to the 8,300 acres of lodgepole pine in the Poorman Creek area, the Helena National Forest has an additional 10,000 acres of similar lodgepole pine timber type for which there is little market.

Forest Products Industry in the Vicinity—A large post-and-pole operation is located just east of Lincoln in close proximity to the area. Other more distant (and smaller) post-and-pole operations include three located in the Drummond-Hall-Philipsburg area, one in Deer Lodge, one near Avon, and one south of Helena. Sawmills manufacturing 2- by 4-inch studs operate in Deer Lodge, Drummond, and Hall. The Missoula area, 84 highway miles west of Lincoln, has several sawmills, a plywood plant, a particleboard plant, and a kraft pulp mill.

Population in the Vicinity—In 1984 Lewis and Clark County had a total population of 45,800. Helena, the county seat, had a population of 23,938 in 1980. Population in Lincoln and the surrounding area is about 800. In July 1986, 6.8 percent of those in the workforce in the county were unemployed. Annual per-capita income in Lewis and Clark County was $12,270 in 1984.

KOOTENAI NATIONAL FOREST

Area Name and Location—The Zulu-Smoot area (figs. 4-8, 4-23, and 4-24), which lies at an elevation of 3,700 to 6,500 feet at latitude 48°43' and longitude 115°35', is in the Yaak Ranger District of the Kootenai National Forest; the Ranger Station is 18 miles north of Troy.

The gross area of about 5,000 acres includes about 4,200 acres of lodgepole pine timber type and falls entirely within Lincoln County; Libby is the county seat. The area is centered in the Zulu and Smoot Creek drainages immediately east of State Highway No. 506; it lies 10 air miles south-southeast of Yaak on a heading of 155° and 22 air miles north-northwest of Libby on a heading of 350°.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Yaak, Lost Horse Mountain, Flatiron Mountain, and Pink Mountain.

Access—All-weather State Highway No. 506 between Libby and Yaak lies within the area, and parallels its western border. Except for the northeast corner of the area, where a Forest Service road bisects the timber body, other quadrants of the area have roads only to perimeters (fig. 4-23).

The nearest railhead is Libby (Burlington Northern), 25 highway miles distant, at an elevation of about 2,000 feet. Moyie Springs, ID, 43 miles northwest of Libby, is a railhead on the Union Pacific line. For highway distances from Libby to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 3,700 and 6,500 feet elevation, with about four-fifths of the acreage having slopes less than 45 percent. Soils are comprised of 10 to 12 inches of volcanic ash overlaying glacial till. There are no special terrain obstacles to harvesting (fig. 4-24) except for some rock outcroppings at the uppermost elevations.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals about 35 inches. The snow-free season generally extends from about mid-April to mid-November.

General Character of the Timber—Analysis of 10 stands of lodgepole pine timber type in the area suggests that the average acre has about 1,679 live trees, of which 1,270 are lodgepole pine. Of these 1,270 trees, which average 4.7 inches in d.b.h. and 48 feet in height, 402 measure less than 3 inches in d.b.h. Considerable dead timber is on the ground or in the slow process of falling to the ground (fig. 4-25). Trees are generally about 65 years old, dating from a major forest fire in 1920.

About 28 percent of the live lodgepole trees in the five stands for which data are in hand have some kind of stem damage—mostly multiple, deep scars resulting from disease and animal activity (fig. 4-26). The overall stem-damage rate may well be higher than indicated by these five stands.

Mortality from mountain pine beetle is not expected to be a problem in the area.

There have been no significant commercial harvests in the area, but in an effort to rehabilitate the forest, 170 acres were bulldozed and piled in 1984, and burned and planted in 1986; another 37 acres were trampled in 1986 (fig. 4-24).

Data on Sample Trees—A pair of adjacent 3½- to 4-inch codominants growing at 4,200 feet on a gentle slope

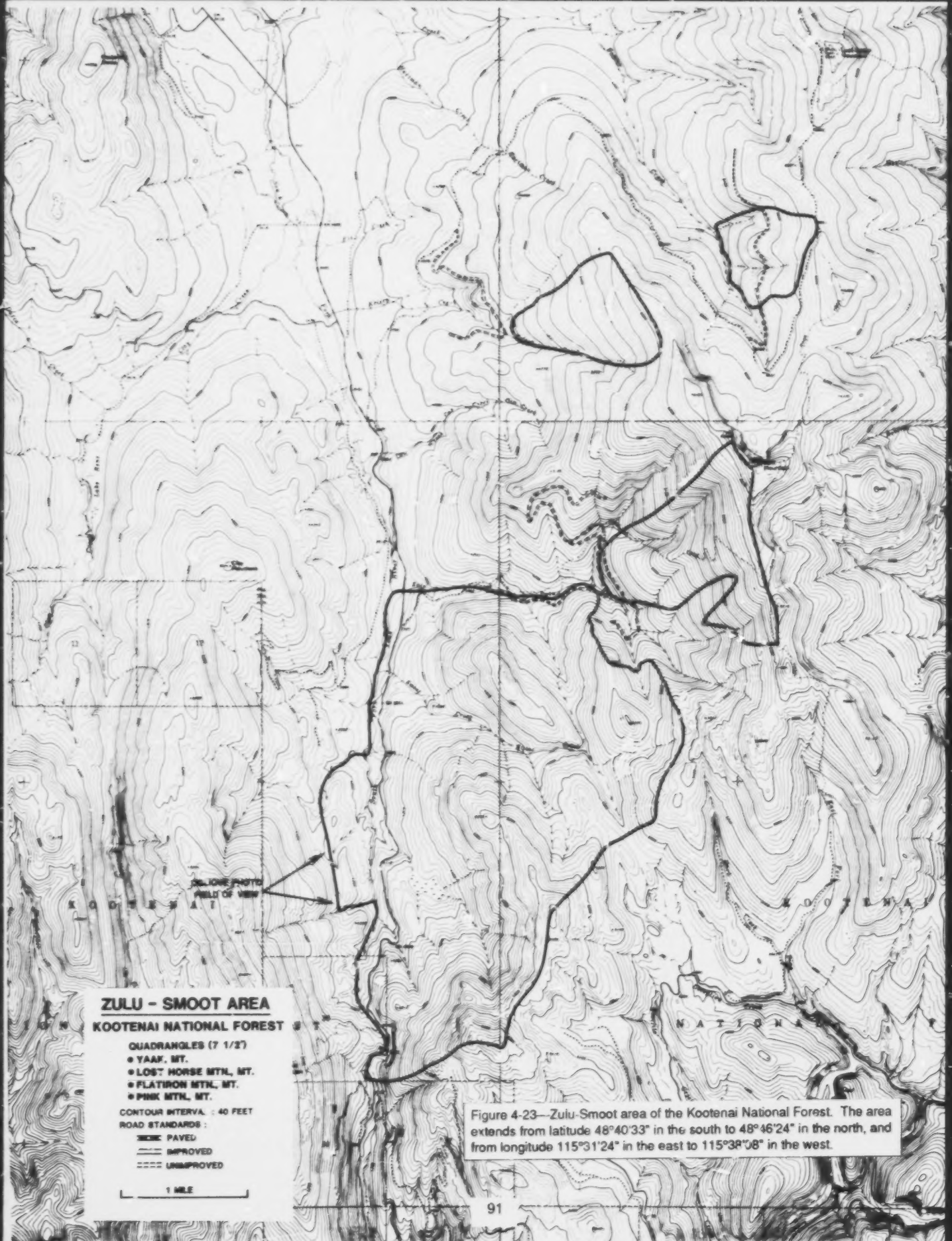

Figure 4-23—Zulu-Smoot area of the Kootenai National Forest. The area extends from latitude 48°40'33" in the south to 48°46'24" in the north, and from longitude 115°31'24" in the east to 115°38'08" in the west.

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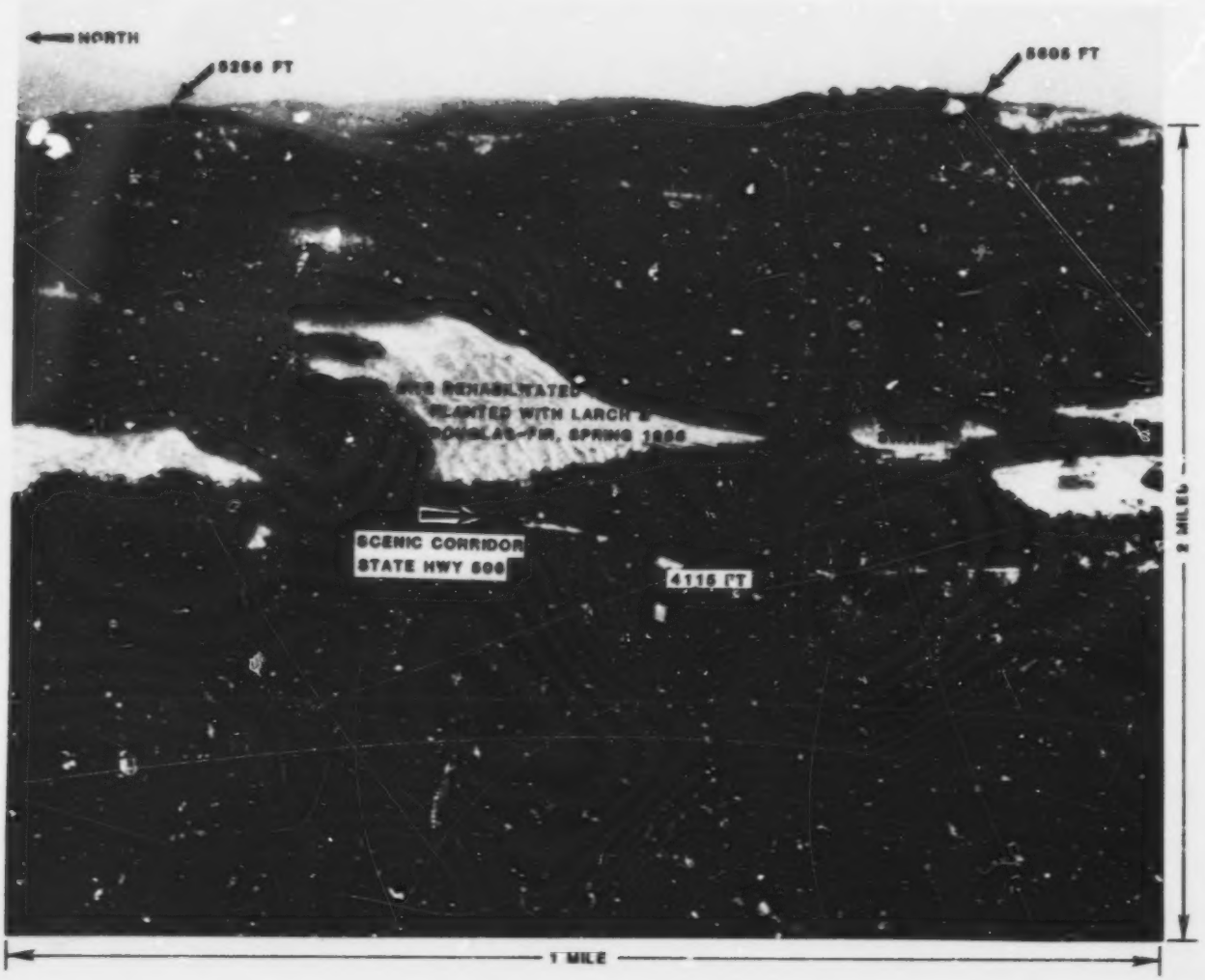

Figure 4-24—Oblique view of the Zulu-Smoot area of the Kootenai National Forest looking west across State Highway No. 506 and three rehabilitated (cleared and planted) acreages toward the head of Smoot Creek; see figure 4-23 for camera viewpoint and field. Width of skyline shown is about 1½ miles; from foreground to skyline in the background is about 2 miles.

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Figure 4-25—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled at 4,200 feet near the lower edge of the largest rehabilitated area in the Zulu-Smoot area of the Kootenai National Forest.

Figure 4-26—A pair of deep stem scars (upper half of photo) probably caused by porcupine damage at early tree age. Such multiple scars were typical on a significant proportion of the trees observed in the Zulu-Smoot area of the Kootenai National Forest.

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just east of State Highway No. 506 and below the rehabilitated areas were destructively sampled (fig. 4-25). Some pertinent tree characteristics follow These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.60	3.90
Tree height above 6-inch high stump, feet	48.0	51.5
Crown ratio, percent	34.8	43.7
Cone serotiny	closed	closed
Tree age years (number of annual growth rings)		
Stump height	62	70
20 percent of tree height	46	60
Base of live crown	- not measured -	
Diameter inside bark, inches		
Stump height	3.54	3.75
20 percent of tree height	2.95	3.18
Base of live crown	2.00	2.50
Height from stump top to base of crown, inches	376	348
Stem taper inside bark, inches/ 100 inches		
Below crown	0.41	0.39
Within crown	1.00	0.95
Rings/inch, average for section		
Stump height	35	37
Base of live crown	- not measured -	
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	66.7	73.8
Specific gravity, ovendry weight and green volume	0.473	0.519
Rings/inch in first 1¼ inches radius	36	32
Ultimate compressive strength, lb f/in²	7,190	8,730
Proportional limit, lb f/in²	5,760	5,590
Modulus of elasticity, lb f/in²	1,870,000	2,090,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	0	0
Bark thickness, single, inch	0.13	0.16
Pith eccentricity, inch	0	0.1

Inventory Data--Inventory data on the area are not complete. Data from several typical stands of lodgepole pine timber type in the area are averaged, however, under the previous pararaph heading, "General Character of the Timber."

Cubic Yield Potential and Height Growth—Although not well documented, potential growth of managed lodgepole stands in the area is estimated at 120 ft³ per acre per year. Fifty-year height growth in managed stands is estimated to be about 60 feet.

Management Objectives for the Area and Constraints—The site is good for lodgepole pine. Managers of the area would therefore like to see a phased replacement—over the next 20 years—of about 2,100 acres of the present stagnated stands with vigorous, new, controlled-density lodgepole (or mixed-species) stands. The harvests must be timed to enhance wildlife habitat (particularly that of grizzly bears), watershed values, and visual quality (especially along State Highway No. 506).

Other Lodgepole Pine Available in the Area From Public Lands—There are about 16,300 acres of stagnated lodgepole pine on the Yaak Ranger District, and about 94,000 acres of stagnated lodgepole on the entire Kootenai National Forest. The Forest Plan calls for replacement of 34 percent of these stands in the next 50 years, or 640 acres per year.

Forest Products Industry in the Vicinity—There is a major forest products manufacturing complex located at Libby, but it is not presently designed to process subsawlog-size lodgepole pine. Three sizable sawmills manufacturing random-length dimension lumber are located near Eureka, but they are not designed for subsawlog-size lodgepole pine.

Two sizable mills manufacturing 2- by 4-inch studs are located near Bonners Ferry, ID, and another one at Olney, MT. Also, there is a small sawmill located between Yaak and Troy. Manufacturers of roundwood include a post-and-pole operation near Bonners Ferry and a house log producer near Eureka.

The nearest pulp mill is near Missoula, about 190 miles from Libby.

Population in the Vicinity—Lincoln County has a total population of 18,700, based on 1984 statistics. The county seat of Libby is the largest community in the county, with 2,748 people within the town limits and 10,960 within a 4-mile radius (1980). In 1984 the per-capita income was $8,881. In July 1986, 10.1 percent of those in the workforce were unemployed.

REFERENCES

Green, Alan W.; O'Brien, Renee A.; Schaefer, James C. 1985. Montana's forests. Resour. Bull. INT-38. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 70 p.

Hawkins, Charles H., III. 1987. Lodgepole pine stand characterization summary: Poorman Creek study unit, Helena National Forest. Unpublished report on file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT. 23 p.

Van Hooser, Dwane D.; Chojnacky, David C. 1983. Whole tree volume estimates for the Rocky Mountain States. Resour. Bull. INT-29. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 69 p.

CHAPTER 5: OREGON

INTRODUCTION

In Oregon, lodgepole pine predominates on about 1.9 million acres of the State's commercial forest land, with about 4.0 billion ft³ of lodgepole pine growing stock and 10.6 billion bd ft of sawtimber (table 5-1). Approximately 5 percent of the softwood growing stock and 3 percent of the softwood sawtimber in the State is lodgepole pine (Farrenkopf 1977; Gedney 1982).

Approximately 46 percent of the lodgepole pine growing stock in Oregon is in trees smaller than the 10-inch d.b.h. class (table 5-2).

The three areas selected for study by managers of public forest lands in Oregon (fig. 5-1) total 24,161 acres in gross area; they are individually described in the following text.

Table 5-1—Volume of lodgepole pine growing stock and sawtimber, and acreage in lodgepole pine, by ownership class, Oregon[1]

Ownership class	Growing stock[2]	Sawtimber volume[3]	Commercial timberland area[4]
	Million ft³	*Million bd ft International ¼-inch scale*	*Thousand acres*
National Forest (commercial)	3,257	7,792	1,442
Other public	204	776	95
Forest industry	352	1,489	233
Other private	155	560	149
Total	3,968	10,617	1,919

[1]Sources: Farrenkopf (1981), Gedney (1982).

[2]**Growing stock volume** = net volume in cubic feet of live sawtimber and pole timber trees (5 inches d.b.h. and larger) from stump to a minimum 4-inch top outside bark, or to the point where the central stem breaks into limbs.

[3]**Sawtimber volume** = net volume in board feet of the sawlog portion of live sawtimber trees. Sawtimber trees are live trees of commercial species, 9 inches in d.b.h. or larger (softwood), containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect.

[4]**Commercial timberland** = forest land that is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. Areas qualifying as commercial timberland have the capability of producing in excess of 20 ft³ per acre per year of industrial wood in natural stands.

Table 5-2—Distribution of lodgepole pine growing stock cubic volume by diameter class—Oregon[1]

Diameter class	Volume of growing stock[2]		
	Eastern Oregon[3]	Western Oregon[3]	Total
Inches	*Million ft³*		
6	1,013	33	1,046
8	740	48	788
10	709	49	758
12	561	47	608
14	316	26	342
16	195	19	214
18	100	9	109
20	51	4	55
22-28	43	5	48
29+	2	0	2
Total	3,730	240	3,970

[1]Sources: Farrenkopf (1981), Gedney (1982).

[2]**Growing stock volume** = net volume in cubic feet of live sawtimber and pole timber trees (5 inches d.b.h. and larger) from stump to a minimum 4-inch top outside bark, or to the point where the central stem breaks into limbs.

[3]Eastern Oregon = area east of crest of Cascade Range; western Oregon = area west of crest of Cascade Range.

Figure 5-1—Oregon location map. 1. Mount Hood NF (Pinhead Butte) 3,910 acres. 2. Malheur NF (Crawford Meadow) 4,251 acres. 3. Fremont NF (Witham) 7,200 acres.

FREMONT NATIONAL FOREST

Area Name and Location—The Witham area (figs. 5-2, 5-3, and 5-4), which lies at an elevation of 6,500 to 7,700 feet at latitude 42°39' and longitude 120°45', is in the Paisley Ranger District of the Fremont National Forest; the Ranger Station is in Paisley.

The gross area of about 16,000 acres includes about 12,800 acres of lodgepole pine timber type (the balance is about evenly divided between meadows and ponderosa pine type) and falls entirely within Lake County; Lakeview is the county seat. The area is centered around Boulder and Witham Creeks, which are about 5 and 7 air miles south of Summer Lake, respectively. The north-central border of the area is about 4½ air miles due west of Paisley. The center of the area is 39 air miles northwest of Lakeview on a heading of 325°, and is 45 air miles north of the California border.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Slide Mountain, Harvey Creek, Coffee Pot Creek, and Lee Thomas Crossing.

Administrative Constraints—The area lies within the Lakeview Federal Sustained-Yield Unit. Management regulations for the unit stipulate that the timber cut in the unit must be milled (through the green chain in the case of lumber) in the immediate vicinity of Paisley or Lakeview. Bidders on unit timber may not bid on USDA Forest Service timber outside of the unit for milling in Lakeview or Paisley, but may bid on non-Forest Service timber.

Access—An all-weather gravel road leads 22 miles southwest from Paisley (elevation 4,443 feet) to the center of the southern border of the area (at the junction of Forest Service Roads No. 331 and No. 2823 just north of Ingram Guard Station and close to the camera viewpoint noted on figure 5-3; elevation 6,560 feet). This road junction is 49 road miles from Lakeview (elevation 4,726 feet) via forest roads. Forest Service all-weather road No. 2823 forms the western border of the area. A dirt road traversible by two-wheel-drive vehicles crosses the north-central portion of the area from west to east, and another dirt road penetrates the southern portion.

The nearest railhead is Lakeview on the Goose Lake 55 railroad. This Lake County-owned railroad connects with the Southern Pacific railroad at Alturas, CA, about 55 miles to the south. Lakeview is 45 miles south of Paisley via State Highway No. 31 and U.S. Highway No. 395. For highway distances from Lakeview to various market centers in the United States, see table 1-2.

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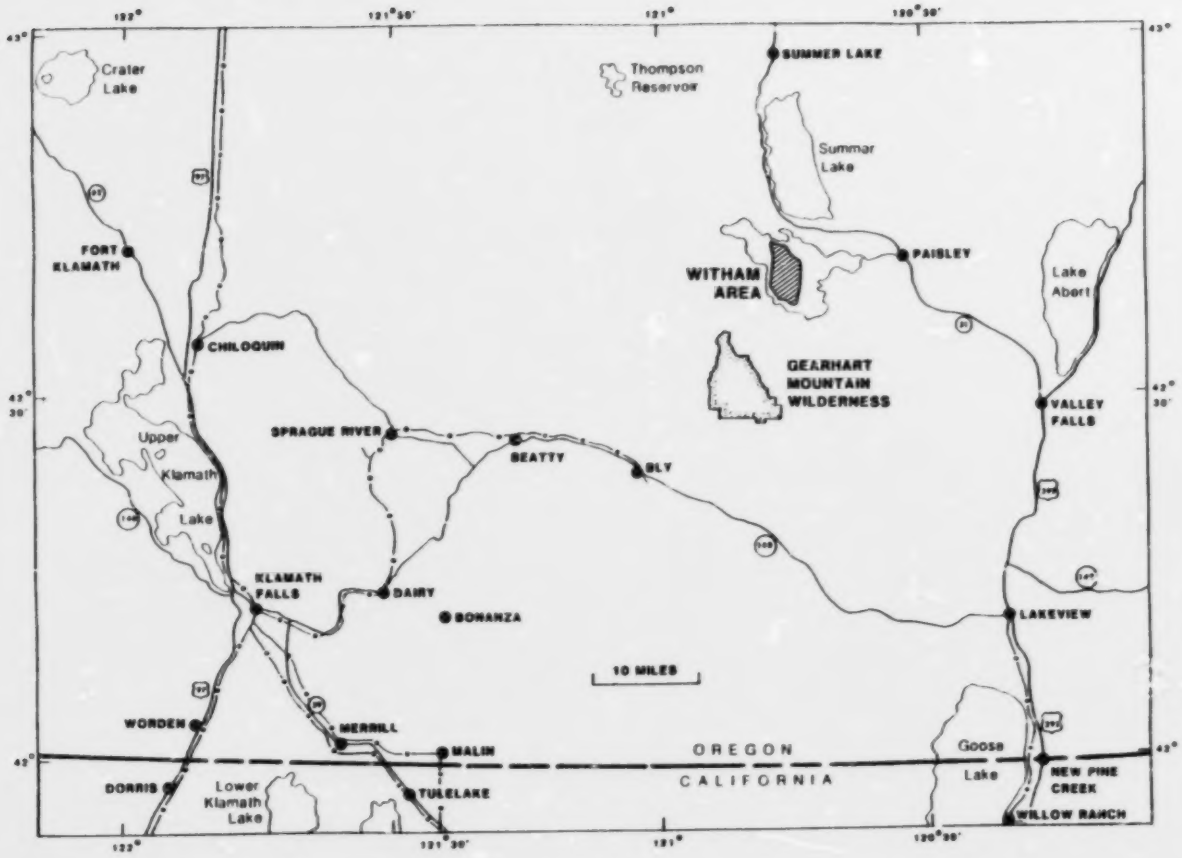

Figure 5-2—Vicinity map for the Witham area of the Fremont National Forest in Oregon.

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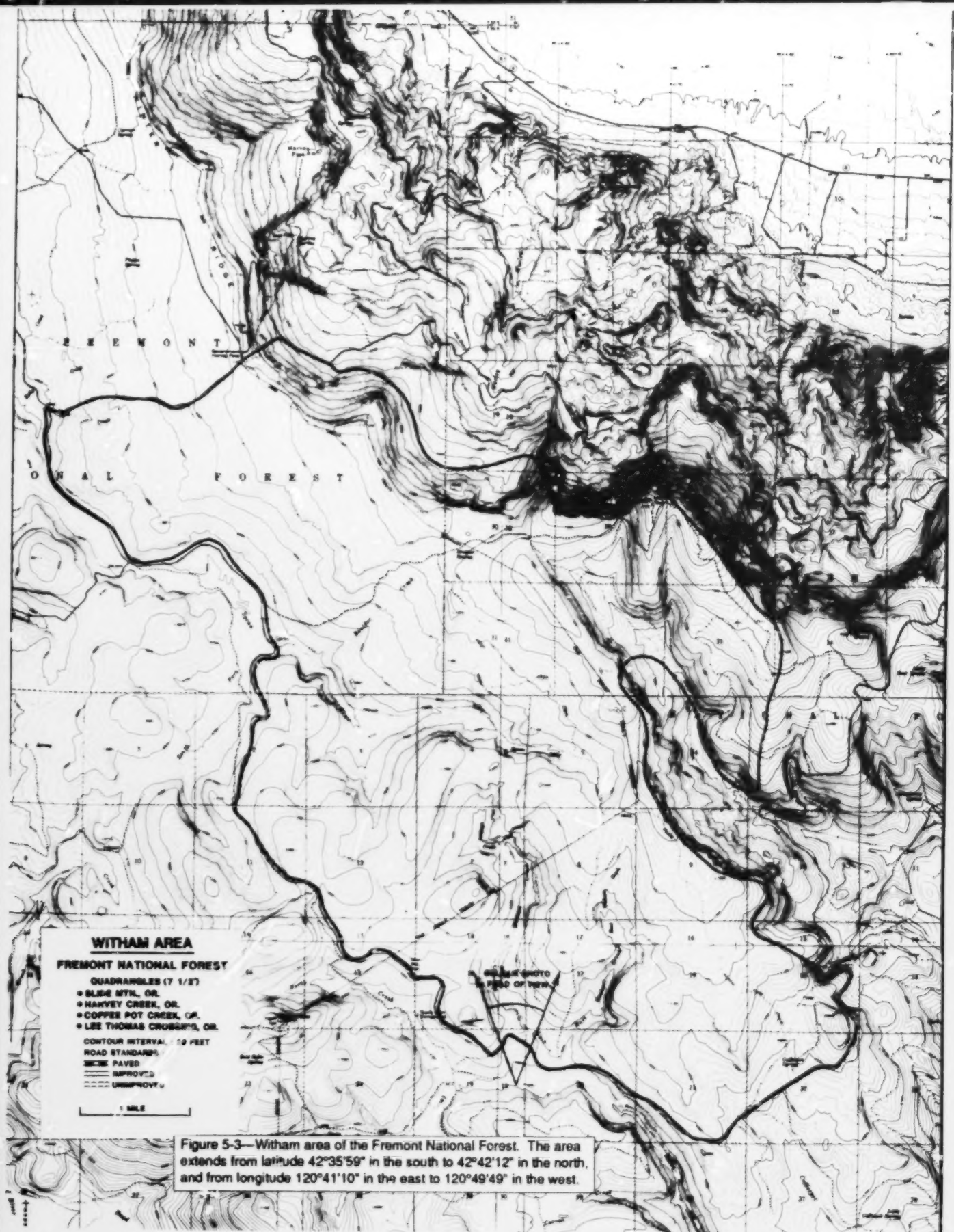

Figure 5-3—Witham area of the Fremont National Forest. The area extends from latitude 42°35'59" in the south to 42°42'12" in the north, and from longitude 120°41'10" in the east to 120°49'49" in the west.

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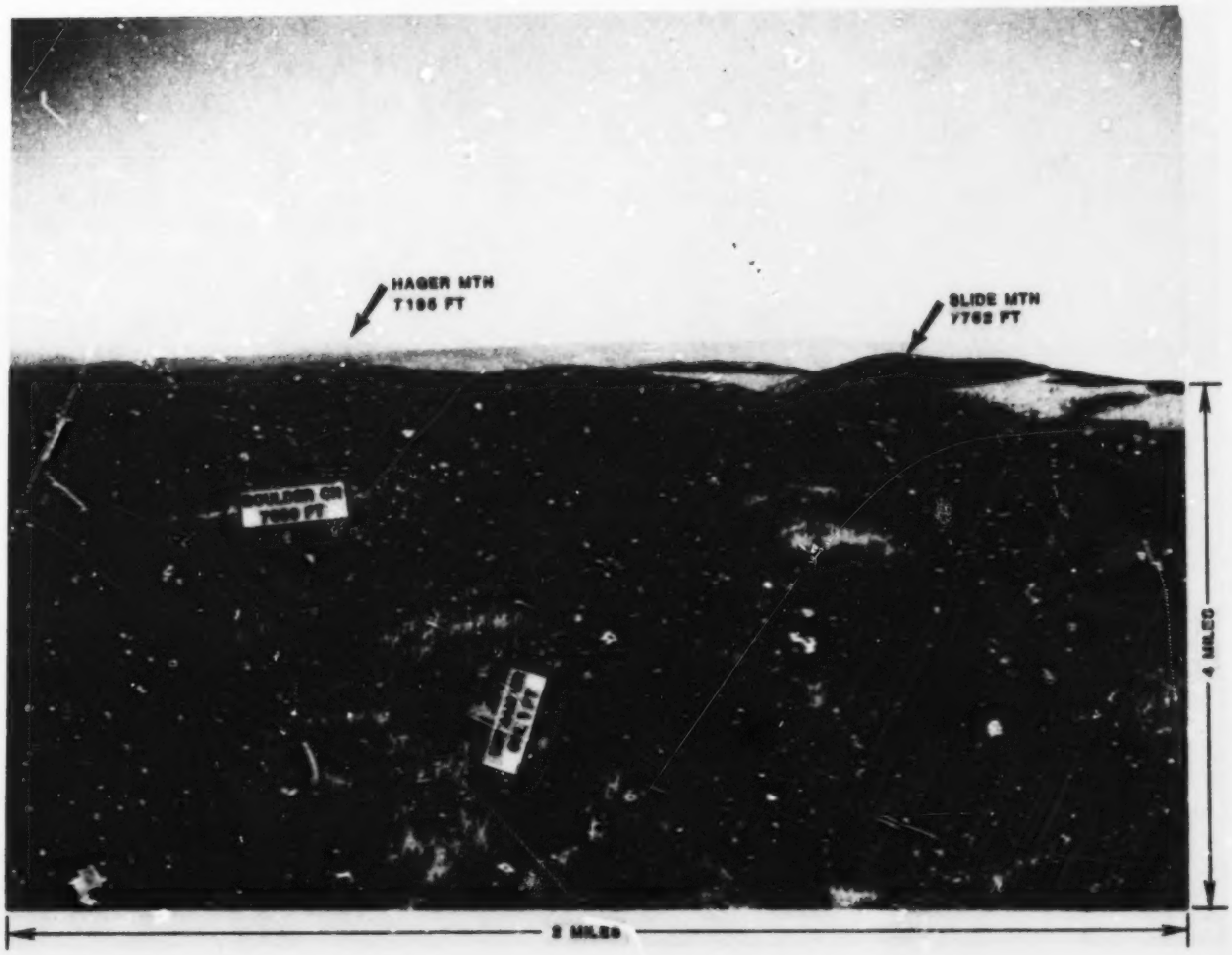

Figure 5-4—Oblique view of the Witham area of the Fremont National Forest looking north up Witham Creek toward Slide Mountain and Summer Lake at upper right. Width of foreground is about 2 miles; from foreground to the top of Slide Mountain is about 4 miles. See figure 5-3 for camera viewpoint and field.

Terrain and Soil—As previously noted, the area lies between 6,500 and 7,700 feet elevation, with nine-tenths of the area having slopes less than 45 percent. Soils are of pumice, a lightweight volcanic ash, several feet deep. There is virtually no undergrowth, and very little dead timber on the ground (figs. 5-5 and 5-6). Except for erodible soils, there are no special obstacles to harvesting.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals about 25 inches. Winter snow accumulation is commonly 3 to 4 feet. The snow-free season generally extends from June 1 to mid-October.

General Character of the Timber—The overstory trees—survivors from past mountain pine beetle attacks—are 150 to 200 years old and not very tall (fig. 5-5). For example, a dominant lodgepole 11 inches in d.b.h. felled 3 miles north of the road intersection mentioned earlier measured only 53 feet in height and was 195 years old. Typically there is a sparse understory among the older relicts. Crown ratios are generally greater than 50 percent. In the vicinity of the area shown in figure 5-5, there averaged about 450 live lodgepole pines per acre larger than 3 inches in d.b.h.; the 450 averaged about 7 inches in d.b.h. Typically there is little ground vegetation and virtually no duff. Meadows and stream bottoms evidently afford considerable forage, however, because mule deer are numerous in the area.

Lower stem sections of a significant proportion of trees near the previously mentioned road junction on the southern border of the area are deeply scarred (fig. 5-6).

There is no significant dwarf mistletoe infestation in the area, and little current mortality from mountain pine beetle. Managers predict, however, that the mountain pine beetle will kill most of the larger trees within 15 years.

Within the area there have been no significant harvests in the past, and none are planned in the immediate future because of lack of markets for the stumpage, and because of an average maintenance levy of about $10 per M bd ft Scribner scale for sawlogs hauled over Forest Service roads leading to area mills.

Data on Sample Trees—A pair of lodgepole pines measuring 3½ to 4 inches in d.b.h. were destructively sampled from the tall understory of a stand adjacent to,

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Figure 5-5—Typical stand of lodgepole pines at 7,250 feet along the southwestern edge of the Witham area of the Fremont National Forest (immediately adjacent to where a pair of trees were destructively sampled). Excluding those less than 3 inches in d.b.h., these trees averaged about 7 inches in d.b.h.

Figure 5-6—Deep butt scars of unidentified origin were evident in a significant number of lodgepole pines growing in the southwest quadrant of the Witham area of the Fremont National Forest.

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and similar to, the stand depicted in figure 5-5. Some pertinent tree characteristics follow. These data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.73	3.62
Tree height above 6-inch high stump, feet	24.7	25.3
Crown ratio, percent	68.6	72.9
Cone serotiny	open	open
Tree age years (number of annual growth rings)		
Stump height	121	114
20 percent of tree height	62	51
Base of live crown	46	42
Diameter inside bark, inches		
Stump height	3.87	3.88
20 percent of tree height	3.46	3.36
Base of live crown	3.29	3.16
Height from stump top to base of live crown, inches	93	82
Stem taper inside bark, inches/100 inches		
Below crown	0.62	0.88
Within crown	1.62	1.43
Rings/inch, average for section		
Stump height	63	59
Base of live crown	28	27
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	92.0	136.2
Specific gravity, ovendry weight and green volume	0.471	0.390
Rings/inch in first 1¼ inches radius	33	34
Maximum crushing strength, lb f/in²	5,410	4,390
Proportional limit, lb f/in²	2,830	2,290
Modulus of elasticity, lb f/in²	840,000	740,000
Compression wood evident?	slight	significant
Spiral grain angle at surface, degrees	2	1
Bark thickness (single), inch	0.13	0.11
Pith eccentricity, inch	0.1	0.1

Inventory Data—Inventory data on the area are incomplete. As previously mentioned, most of the stands are comprised of old trees that are relicts of previous attacks by mountain pine beetle, with a sparse understory of smaller trees. Data from examination #877 made in 1981 on 4,388-acre compartment 3207 in the area yielded the following diameter distribution:

Diameter class *Inches*	Live trees per acre
1.0-1.9	125
2.0-2.9	71
3.0-3.9	107
4.0-4.9	18
5.0-6.9	80
7.0-8.9	33
9.0-10.9	58
11.0-12.9	27
13.0-14.9	11
15.0-16.9	6
17.0-18.9	2
Total	538

The lodgepole pines in this stand, which had 235 live trees in the 4-inch and larger classes, are somewhat larger than the average for the entire area. Since 1981 bark beetles have killed many of the larger trees in this compartment.

Cubic Yield Potential and Height Growth—Although data are not well documented, managers of the area estimate that managed lodgepole stands in the area should grow 20 to 30 ft³ of stemwood per acre per year. Fifty-year height growth in managed stands is estimated to be about 35 feet.

Management Objectives for the Area and Constraints—Because of lack of stumpage markets, in part due to road maintenance costs levied on loggers, attainment of management objectives is hard to accomplish. The primary objective is phased harvest of the overaged decadent stands and replacement with vigorous, new, controlled-density lodgepole stands. Such harvests must be timed to enhance wildlife habitat (particularly that of deer) and preserve watershed values.

Sawtimber stumpage within the area, in the few sales accomplished, is usually sold for about $5 per M bd ft Scribner scale plus about $10 per M bd ft for road maintenance. Commercial firewood cutters pay a minimum of $5 per cord stumpage plus $1 per cord for road maintenance.

Other Lodgepole Pine Available in the Area From Public Lands—Within the unit there are another 6,000 acres (additional to that within the Witham area) of similar lodgepole pine timber mixed among stands of other species.

Outside of the unit, but within the Fremont National Forest, there are still another 111,000 acres of lodgepole pine timber type.

Forest Products Industry in the Vicinity—The unit supplies logs—mostly large ponderosa pine and white fir—to five sawmills, each cutting 12 to 16 million bd ft of random-length lumber. One of the mills is in Paisley, and the remaining four are in Lakeview. One of the Lakeview mills is building a facility to mill small white fir logs.

Not drawing logs from the unit are the substantial and various wood conversion operations in Klamath Falls, about 95 highway miles west of Lakeview.

Population in the Vicinity—Lake County has a total population of 7,600, based on 1984 data. Lakeview has a population of about 2,800 and Paisley about 360.

In 1985, annual per-capita income in the county was $14,600; 12.5 percent of the workforce in the county was unemployed in January 1986.

MALHEUR NATIONAL FOREST

Area Name and Location—The Crawford Meadow area (figs. 5-7, 5-8, and 5-9), which lies at an elevation of 4,600 to 5,800 feet at latitude 44°37' and longitude 118°22', is in the Long Creek Ranger District of the Malheur National Forest; the Ranger Station is in John Day

The gross area of 4,251 acres includes about 2,100 acres of lodgepole pine timber type and falls within Baker and Grant Counties. Baker and Canyon City are the respective county seats. The area, which is about midway on a line between Baker and John Day, surrounds Crawford Meadow and extends east of it. From Austin Junction, the center of the area is about 8 miles northeast on a heading of 55°.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Greenhorn, Whitney, Austin, and Pogue Point.

Access—U.S. Highway No. 26 from John Day east to Austin Junction and Unity runs south of the area. From Austin Junction (28 miles east of John Day on U.S. Highway No. 26), a secondary paved highway (State No. 7) runs northeast 8 miles to Tipton Site—and hence on to Whitney and Baker. Baker is about 33 miles from Tipton Site. Forest Service Road No. 2620 leads south from Tipton Site for about 1 mile to a road junction within the area just northeast of Crawford Meadow at an elevation of 5,137 feet. From this junction an unimproved road leads southeast to the eastern border of the area, and an all-weather road leads southwest past Crawford Meadow and on down Crawford Creek to U.S. Highway No. 26 at Phipps Meadows (figs. 5-8 and 5-9).

The nearest railhead is in Baker on the Union Pacific line between Pendleton and Payette, ID. For highway distances from Baker to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 4,600 and 5,800 feet elevation, with nearly all the acreage having slopes of less than 30 percent. Soils are 30 to 60 inches in depth, with the top 6 to 24 inches derived principally from volcanic ash. Unimproved roads in the area, when dry, are deeply layered in dust. Large stones and rock outcroppings are not evident, and undergrowth is minimal.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals about 25 inches. In winter, snow commonly accumulates to a depth of 4 feet. The snow-free season generally extends from the first of June through October.

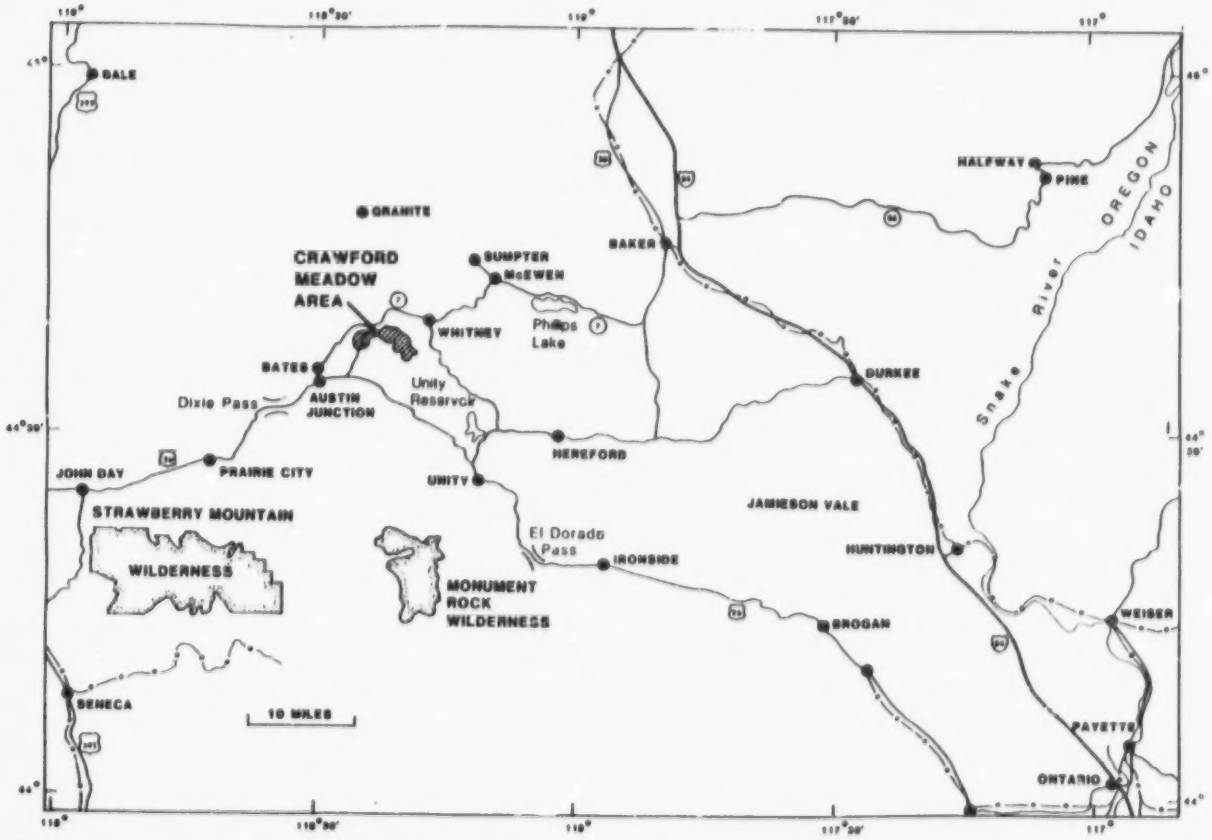

Figure 5-7—Vicinity map for the Crawford Meadow area of the Malheur National Forest.

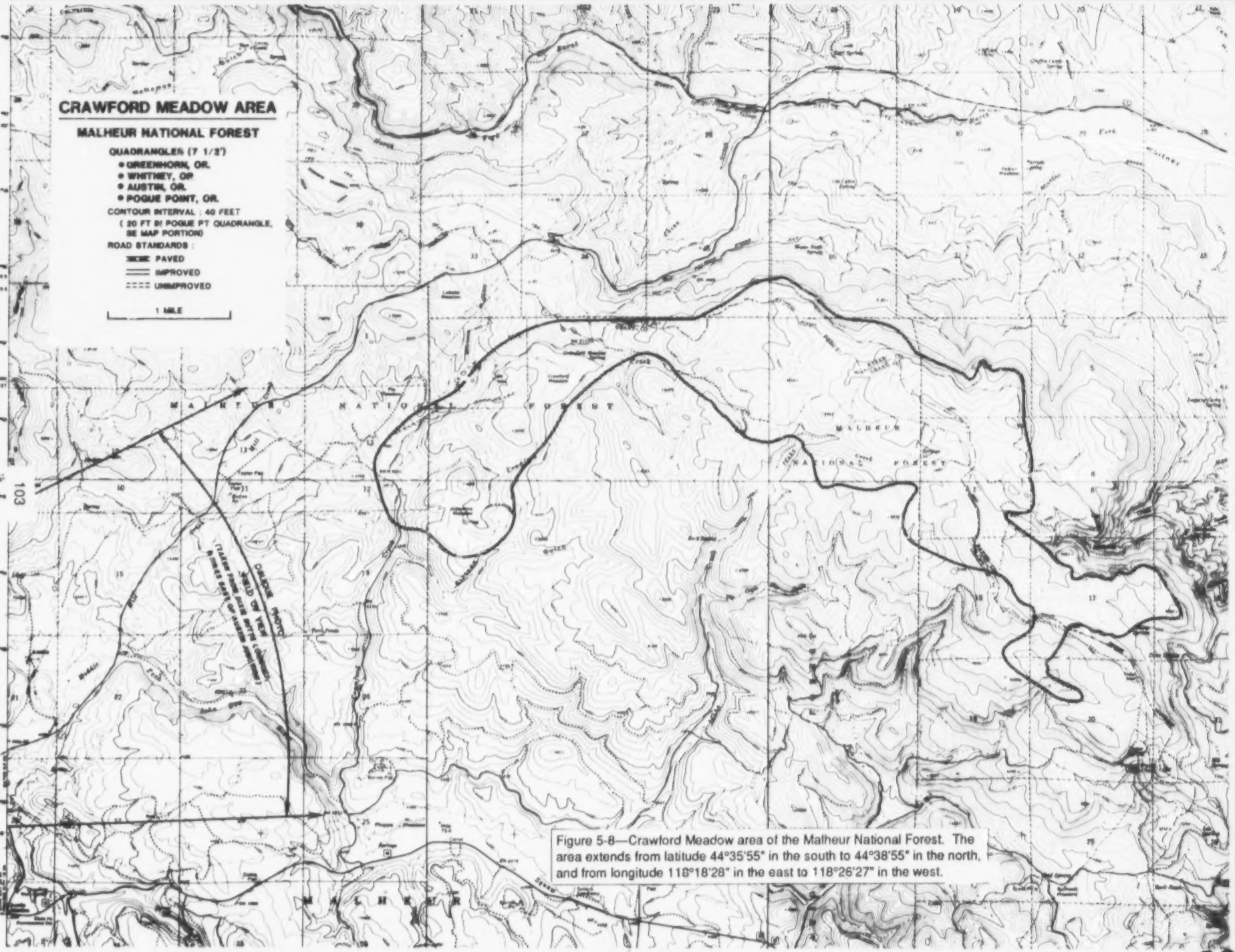

Figure 5-8—Crawford Meadow area of the Malheur National Forest. The area extends from latitude 44°35'55" in the south to 44°38'55" in the north, and from longitude 118°18'28" in the east to 118°26'27" in the west.

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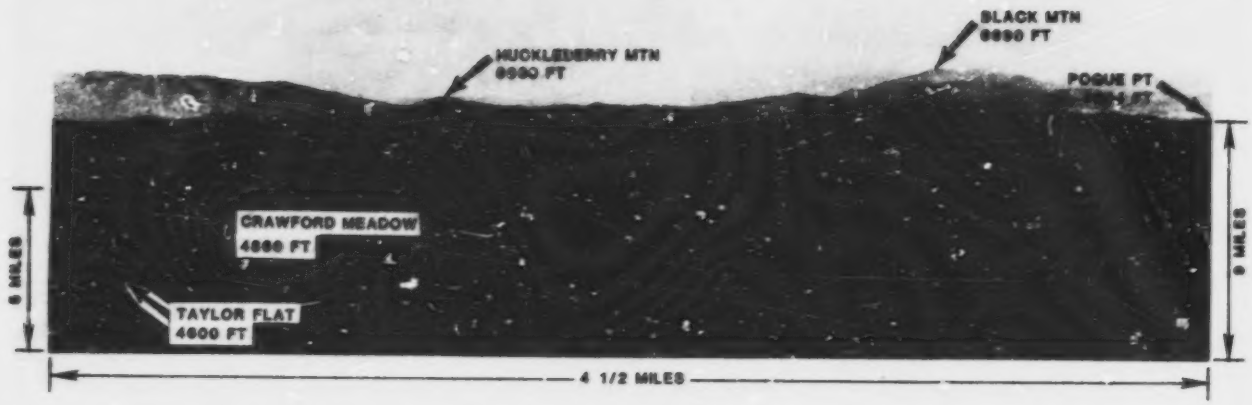

Figure 5-9—Oblique view of the Crawford Meadow area of the Malheur National Forest looking east-northeast from Dixie Butte Lookout. See figure 5-8 for camera field of view. Width of foreground shown is about 4½ miles; from foreground to Pogue Point in the right background is about 9 miles.

General Character of the Timber—Of the 2,100 acres of lodgepole pine timber type in the area, about 1,000 acres carry stagnated dense stands of trees 50 to 60 years old, mostly 2 to 4 inches in d.b.h., and with few trees larger than 6 inches in d.b.h. (fig. 5-10). These stagnated dense stands are mainly to the east of Crawford Meadow on relatively flat ground; many have 3,000 live stems per acre.

Because of significant mortality from past attacks by mountain pine beetles, other stands east of Crawford Meadow have 1,100 to 1,500 live stems per acre along with 600 to 700 standing dead stems and much down timber (fig. 5-11). Natural regeneration occurs easily, and growth on clearcut areas is vigorous (fig. 5-12). On this eastern portion of the area, lodgepole pines that have been thinned to about 150 trees per acre average about 9 inches in d.b.h. at age 52 years.

The lodgepole pines growing on the west end of the area are of somewhat larger diameter than those in the stagnated eastern stands (although not of sawlog size) and are in unthinned mixtures with larch, Douglas-fir, and true firs.

Most of the larger trees in the area have been killed by mountain pine beetles, much dwarf mistletoe is evident on surviving trees, and significant numbers of trees are under attack by western gall rust.

No significant harvests have been made in the area, and none are planned for the immediate future—except for local use as posts and poles.

Data on Sample Trees—A pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. were destructively sampled from level terrain at 5,600 feet elevation about 2½ miles east of Crawford Meadow (fig. 5-11). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Figure 5-10—Sapling/pole stand at 5,600 feet elevation about 2½ miles east of Crawford Meadow in the Malheur National Forest.

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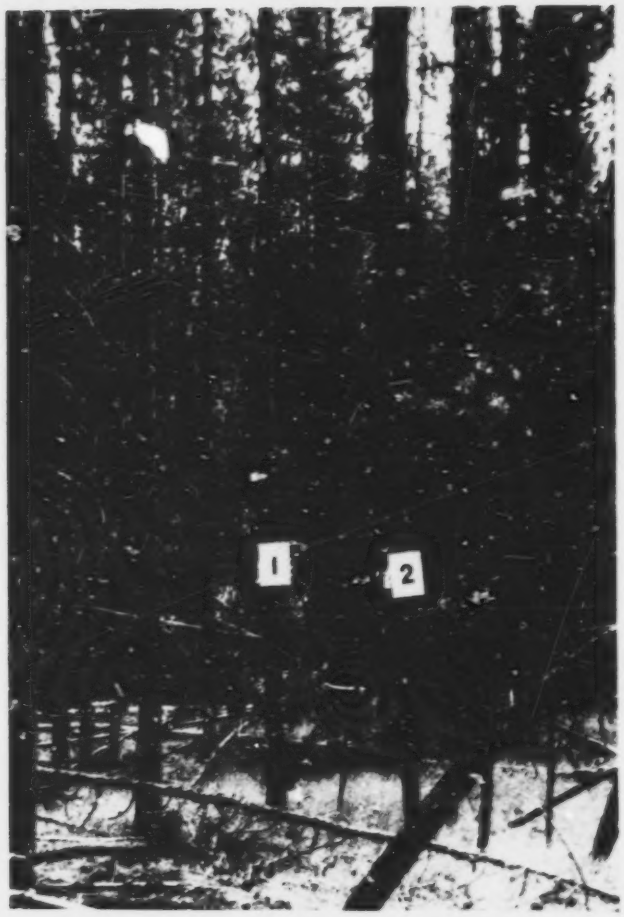

Figure 5-11—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled at 5,600 feet elevation about 2½ miles east of Crawford Meadow in the Malheur National Forest.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.95	3.63
Tree height above 6-inch high stump, feet	37.5	37.8
Crown ratio, percent	59.3	55.6
Cone serotiny	open	open
Tree age years (number of annual growth rings)		
Stump height	55	53
20 percent of tree height	42	21
Base of live crown	34	28
Diameter inside bark, inches		
Stump height	4.07	3.71
20 percent of tree height	3.44	3.32
Base of live crown	3.01	3.10
Height from stump top to base of crown, inches	183	201
Stem taper inside bark, inches/100 inches		
Below crown	0.58	0.30
Within crown	1.13	1.23
Rings/inch, average for section		
Stump height	27	29
Base of live crown	22	18
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	101.7	88.5
Specific gravity, ovendry weight and green volume	0.439	0.431
Rings/inch in first 1¼ inches radius	19	26
Ultimate compresssive strength, lb f/in²	6,650	5,070
Proportional limit, lb f/in²	3,590	3,570
Modulus of elasticity, lb f/in²	1,460,000	1,020,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	1	3
Bark thickness (single), inch	0.12	0.10
Pith eccentricity, inch	0.4	0.1

Figure 5-12—Natural unthinned lodgepole pine regeneration 10 years after completion of a small clearcut (a noncommercial stand replacement operation in which severed stems were bulldozed into piles) in the Crawford Meadow area of the Malheur National Forest.

Inventory Data—Inventory data on the area are lacking. For general comments about diameter classes and stocking, see text under paragraph heading "General Character of the Timber."

Cubic Yield Potential and Height Growth—Although data are not well documented, managers of the area estimate that in managed stands, growth should be about 15 rings per inch at 80 to 100 ft² basal area, yielding about 45

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ft³ of stemwood per acre per year. Fifty-year height growth in managed stands is estimated to be about 40 feet.

Management Objectives for the Area and Constraints—Managers do not plan to thin the present stands. The primary objective is phased harvest of the stagnated stands and replacement with vigorous, new, controlled-density lodgepole stands. Such harvests would be timed to enhance winter range for elk and to preserve watershed values.

Lack of markets for subsawlog-size trees is the major constraint to accomplishment of the objectives. Dead trees harvested for firewood sell for about $2.50 per cord stumpage, and lodgepole pine sawtimber stumpage may bring only $5.00 per M bd ft Scribner scale.

Other Lodgepole Pine Available in the Area From Public Lands—Lodgepole pine timber type comprises only about 5 percent of the acreage on the entire 1,460,000-acre Malheur National Forest, so available lodgepole is limited. The Big Cow Burn area of the Prairie City Ranger District (about 14 miles southeast of Prairie City), however, does contain about 20,000 acres of lodgepole pine timber for which there is little market because trees are small in diameter, short, and have more-than-average taper.

Forest Products Industry in the Vicinity—Except for small-log dimension and stud mills in Prairie City and Long Creek (both associated with a cogeneration plant producing electric power for sale), sawmills in the area mainly cut ponderosa pine. There are two such mills in John Day, one in Pilot Rock, and several in the vicinity of Baker. There are no pulp mills in the vicinity, but there is a fiberboard plant in Pilot Rock.

There are numerous portable mills in the area, including one that mills house logs from lodgepole pine. Also, there is a small post-and-pole operation in Bates.

Population in the Vicinity—In 1984, Grant County had a total population of 8,230. At that time John Day, the largest town in the county, had 2,012 within the city limits and about 4,938 within a 15-mile radius. In 1983, per-capita income in Grant County was $10,737, and 14.4 percent of those in the workforce were unemployed.

Baker County has a total population (1986) of 16,200. The town of Baker, largest in the county and the county seat, has a population of 9,470. In 1980, per-capita income in Baker County was $8,315, and 13 percent of those in the workforce were unemployed.

MOUNT HOOD NATIONAL FOREST

Area Name and Location—The Pinhead Butte area (figs. 5-13, 5-14, and 5-15), which lies at an elevation of 2,700 to 5,500 feet at latitude 44°53' and longitude 121°49', is in the Clackamas Ranger District of the Mount Hood National Forest in Oregon; the Ranger Station is in Ripple Brook.

The gross area of 3,910 acres is entirely forested with lodgepole pine timber type. The northern half of the area is in Clackamas County, and the southern half in Marion County. The county seats are Oregon City and Salem, respectively. The area is centered around the headwaters of the Clackamas River immediately west of, and adjoining, the Warm Springs Indian Reservation. From Mount Hood the center of the area is about 32 air miles south-southwest, and the Mount Jefferson Wilderness area is 2 or 3 miles south of the area's southern border. From Estacada the area is 36 air miles southeast on a heading of 135°.

Map of the Area—The area falls entirely within a single USGS 15' quadrangle map: Breitenbush Hot Springs, OR.

Access—All-weather roads lead from the area to Estacada (47 miles), and to the railhead towns of Mill City (about 50 miles), Molalla (96 miles), and Hood River (96 miles). Although figure 5-14 shows only a few access roads, there is today an extensive network of improved USDA Forest Service roads throughout most of the area.

For highway distances from Portland (that is, from near Molalla and Estacada) to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 2,700 and 5,500 feet elevation, with nearly seven-eighths of the area having slopes less than 45 percent. Litter is 2 to 3 inches thick over a gravelly cobbly loam 6 to 9 inches thick; subsoils are gravelly silt or sandy loams 3 to 4 feet deep. Few large stones or rocky outcroppings are visible.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals 30 to 35 inches, with snow accumulations of 3 to 10 feet common at upper elevations in winter. In spite of the sometimes heavy snow accumulations, logging operations in the vicinity are continued throughout most winters.

General Character of the Timber—Most of the lodgepole pines in the area are both large in diameter and tall for the species (fig. 5-16). A codominant measured east of Sisi Butte was 10.1 inches in diameter and 74 feet in height; most overstory trees in the vicinity were 8 to 12 inches in d.b.h., with numerous 16-inch trees. In comparison to other areas studied, diameter growth is rapid.

While many stands would provide excellent straight house logs of larger than usual diameter, a significant proportion of trees observed had short crooks in lower stem sections (fig. 5-17).

Some infestation by dwarf mistletoe is evident, but there is no mortality from mountain pine beetle. Most trees are 60 to 90 years old (some 150 years old), so it appears that there have been no major forest fires since near the turn of the century.

There has been no harvest activity in recent years, and—lacking markets—none is planned in the near future.

Data on Sample Trees—Two adjacent lodgepole pines 3½ to 4 inches in d.b.h. from the understory of a stand at 4,400 feet elevation just east of Sisi Butte were destructively sampled (fig. 5-18). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees of this diameter.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

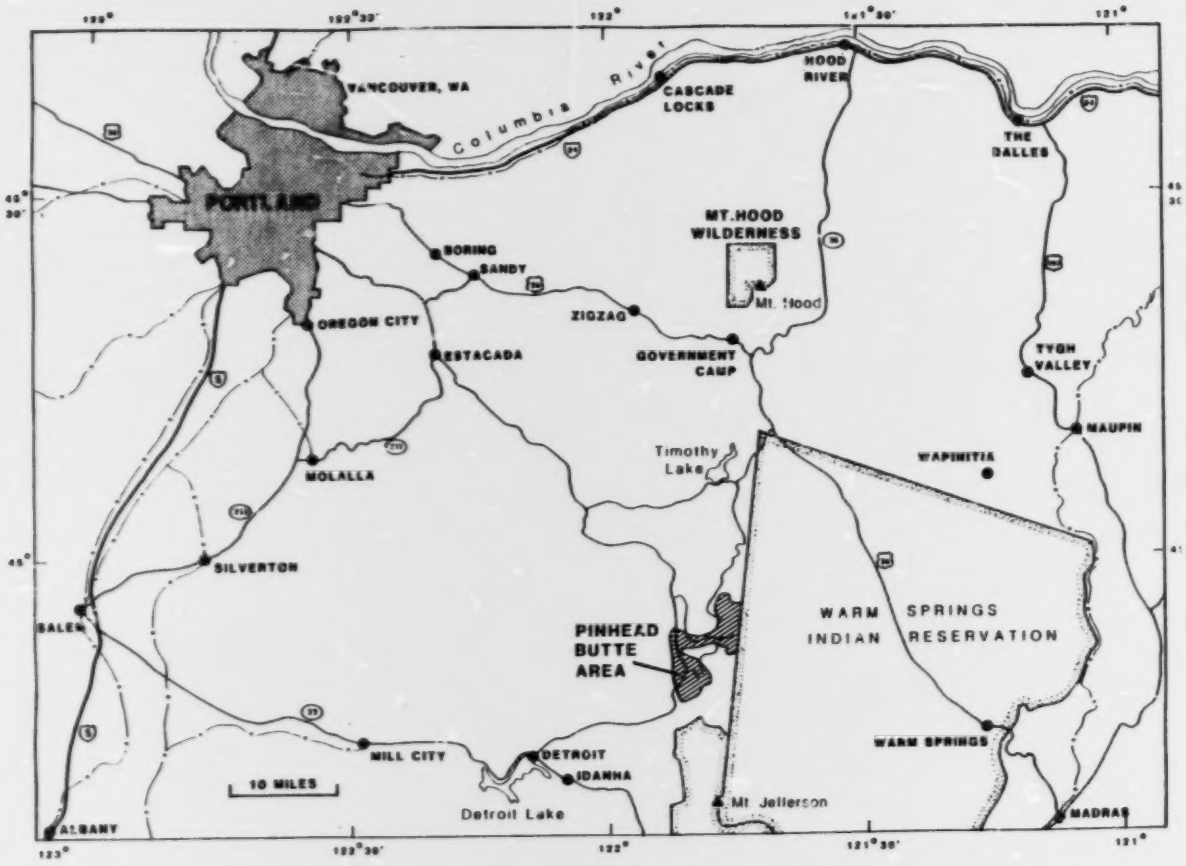

Figure 5-13—Vicinity map for the Pinhead Butte area of the Mount Hood National Forest in Oregon.

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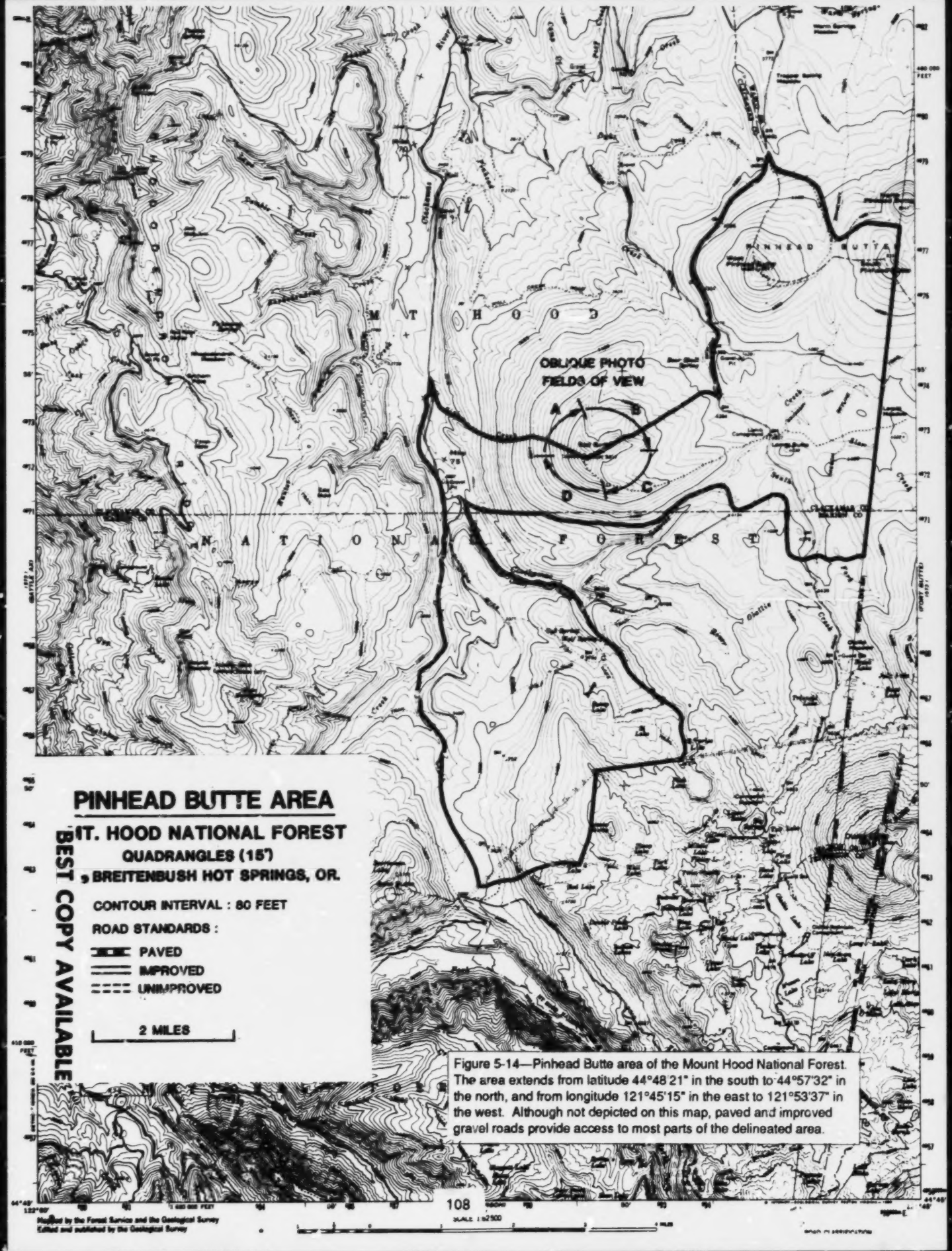

Figure 5-14—Pinhead Butte area of the Mount Hood National Forest. The area extends from latitude 44°48'21" in the south to 44°57'32" in the north, and from longitude 121°45'15" in the east to 121°53'37" in the west. Although not depicted on this map, paved and improved gravel roads provide access to most parts of the delineated area.

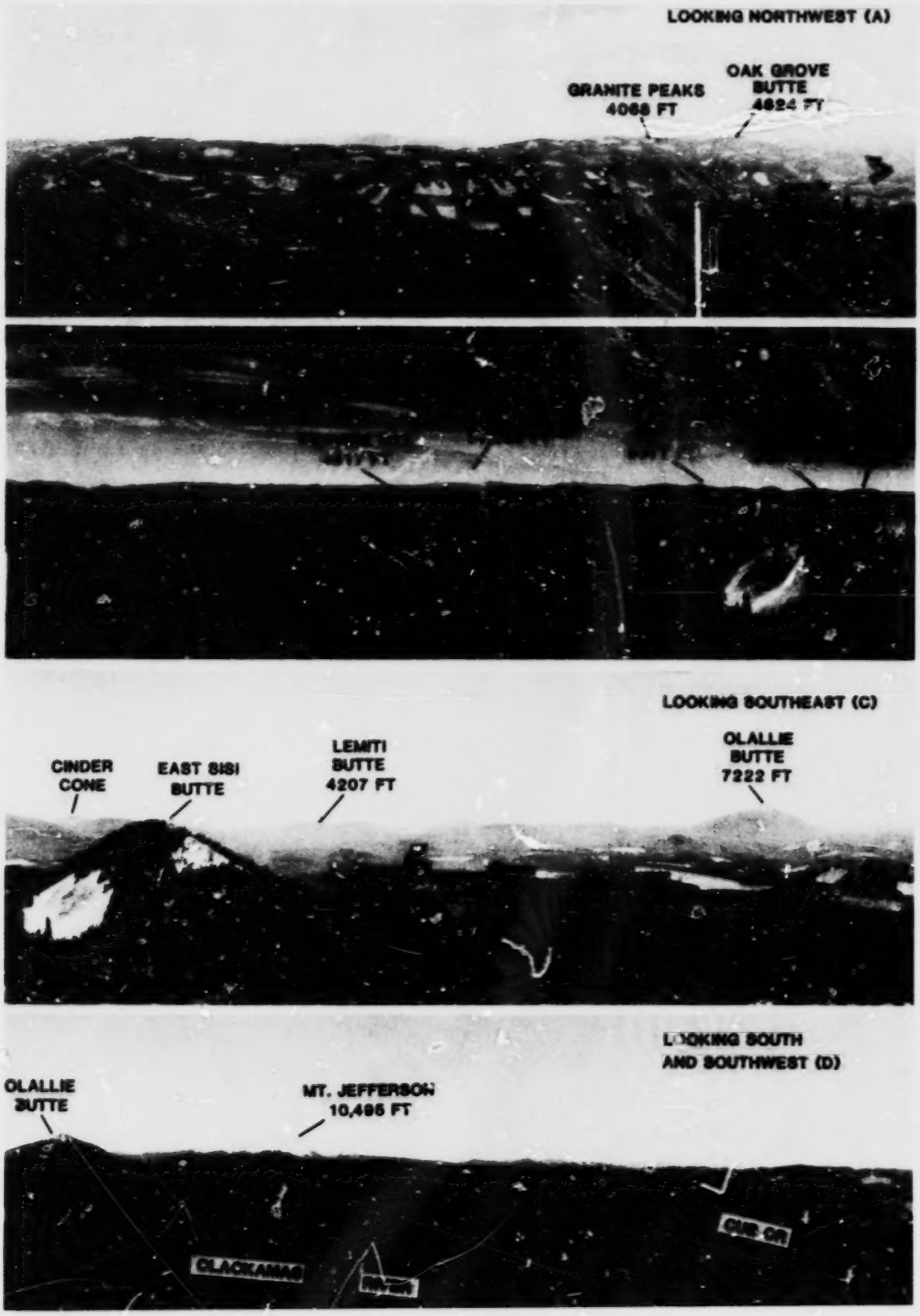

Figure 5-15---The Pinhead Butte area of the Mount Hood National Forest as seen from Sisi Butte through a camera rotated to provide a 360-degree scan in the four views shown. See figure 5-14 for camera viewpoint and fields of each view. The lodgepole pine acreage is in the foreground of each view.

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Figure 5-16—Access road through lodgepole pine mostly 7 to 12 inches in d.b.h. at about 4,400 feet elevation just east of Sisi Butte in the Pinhead Butte area of the Mount Hood National Forest.

Figure 5-18—Pair of lodgepole pines 3½ to 4 inches in d.b.h. sampled from tall understory of a stand at 4,400 feet east of Sisi Butte in the Mount Hood National Forest.

Figure 5-17—Stem crook prevalent in many lodgepole pines found east of Sisi Butte in the Mount Hood National Forest.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.80	3.69
Tree height above 6-inch high stump, feet	28.5	28.8
Crown ratio, percent	41.5	71.3
Cone serotiny	no cones	open
Tree age years (number of annual growth rings)		
Stump height	88	88
20 percent of tree height	61	64
Base of live crown	28	57
Diameter inside bark, inches		
Stump height	3.70	3.90
20 percent of tree height	3.43	3.39
Base of live crown	2.29	3.17
Height from stump top to base of live crown, inches	200	99
Stem taper inside bark, inches/100 inches		
Below crown	0.71	0.74
Within crown	1.61	1.29
Rings/inch, average for section		
Stump height	48	45
Base of live crown	24	57
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	78.7	85.9
Specific gravity, ovendry weight and green volume	0.481	0.487
Rings/inch in first 1¼ inches radius	32	26
Maximum crushing strength, lb f/in²	5,080	5,180
Proportional limit, lb f/in²	1,860	1,060
Modulus of elasticity, lb f/in²	800,000	710,000
Compression wood evident?	much	much

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Characteristic	Tree number 1	Tree number 2
Spiral grain angle at surface, degrees	1	3
Bark thickness (single), inch	0.14	0.14
Pith eccentricity, inch	0.3	0.5

Inventory Data—Available inventory data do not permit generalization about diameter distributions in the entire area. Limited data on a few acreages where lodgepole pine is growing in more-or-less pure stands follow:

Stand and cell/grid	Average d.b.h *Inches*	All live trees of all diameters per acre *Number*	Year of stand origin
3209			
104/B4	10	209	1930
113/C6	9	331	1930
3210			
125/F3	14	137	1850
3211			
219/B5	5	778	1930

Cubic Yield Potential and Height Growth—Although data are not well documented, area foresters estimate that managed lodgepole pine stands in the area have a realizable potential growth of 50 to 84 ft^3 of stemwood per acre per year. Fifty-foot height growth in managed stands is estimated to be about 50 feet (220 trees per acre, 10 inches in d.b.h. at age 50).

Management Objectives for the Area and Constraints—Much of the area in which lodgepole predominates is so cold in winter that other more-favored species cannot be reliably regenerated. The managers of the area, therefore, would like to accomplish a phased replacement of the present mature and/or stagnated stands with vigorous, new, controlled-density lodgepole pine stands. If timed appropriately, such harvests could enhance wildlife habitat and watershed values. Also, because of proximity to both the Mount Hood and Mount Jefferson recreation areas, visual quality of the landscapes in the area must be protected.

Because of the high value of surrounding timber, weight of distributed residual logging slash is limited to 12 tons per acre (green basis)—less than half the tonnage permitted in the other areas studied.

Other Lodgepole Pine Available in the Area From Public Lands—To the east, the Warm Springs Indian Reservation has considerable acreage of similar lodgepole pine, but its extent and availability were not investigated. To the north, the Bear Springs Ranger District of the Mount Hood National Forest has about 1,200 acres of similar lodgepole pine for which there is little current demand.

Forest Products Industry in the Vicinity—Four sizable sawmills—none of which cut lodgepole pine—are located in the vicinity of Detroit, about 25 miles southwest of the area. West of the area there are sawmills at Estacada and Boring; at the latter location some lodgepole pine cants are processed. Another sawmill cutting random-length dimension lumber is located at the railhead town of Molalla, 96 miles distant. Unlike many of the localities where lodgepole pine grows, Pinhead Butte is less than 100 miles from port facilities and markets for pulp chips.

Population in the Vicinity—Clackamas County had a total population of 248,000 in 1981, at which time the population of Oregon City (the county seat) was 14,920, that of Estacada was 1,755, and that of Molalla was 3,100. In 1985 about 6.5 percent of the workforce in the county was unemployed. Average per-capita income in Clackamas County was $12,924 in 1984.

REFERENCES

Farrenkopf, Thomas O. 1981. Forest statistics for eastern Oregon, 1977. Resour. Bull. PNW-94. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 28 p.

Gedney, Donald R. 1982. The timber resources of western Oregon—highlights and statistics. Resour. Bull. PNW-97. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 84 p.

CHAPTER 6: UTAH

INTRODUCTION

In Utah, lodgepole pine predominates on about 460,000 acres of the State's 3.2 million acres of commercial forest land, with about 794 million ft³ of lodgepole pine growing stock and 2.4 billion bd ft of sawtimber (table 6-1). Approximately 22 percent of the softwood growing stock and 16 percent of the softwood sawtimber in the State is lodgepole pine (Van Hooser and Green 1978).

Approximately 50 percent of the dry weight of aboveground biomass in lodgepole pine trees in Utah is in trees smaller than the 10-inch d.b.h. class (table 6-2).

Managers of public forest lands in Utah selected a single case for study—the 16,000-acre Alma Taylor area of the Ashley National Forest (fig. 2-1).

Table 6-1—Volume of lodgepole pine growing stock and sawtimber, and acreage in lodgepole pine, by ownership class, Utah[1]

Ownership class	Growing stock[2]	Sawtimber volume[3]	Commercial timberland area[4]
	Million ft³	*Million bd ft International ¼-inch scale*	*Thousand acres*
National Forest (commercial)	755.2	2,248.8	424.7
Other public	11.8	37.8	11.0
Forest industry and other private	26.9	83.4	24.7
Total	793.9	2,370.0	460.4

[1]Source: Van Hooser and Green (1983). Information presented is based on 1978 data.

[2]**Growing stock volume** = net volume in cubic feet of live sawtimber and pole timber trees (5 inches d.b.h. and larger) from stump to a minimum 4-inch top outside bark, or to the point where the central stem breaks into limbs.

[3]**Sawtimber volume** = net volume in board feet of the sawlog portion of live sawtimber trees. Sawtimber trees are live trees of commercial species, 9 inches in d.b.h. or larger (softwood), containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect.

[4]**Commercial timberland** = forest land that is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. Areas qualifying as commercial timberland have the capability of producing in excess of 20 ft³ per acre per year of industrial wood in natural stands.

Table 6-2—Dry weight of lodgepole pine trees, by tree component and diameter class—Utah[1]

Diameter class	Bole[2]	Top[2]	Total
Inches	*Thousand tons, ovendry basis*		
2	—	486	486
4	—	1,669	1,669
6	2,160	1,195	3,355
8	2,304	749	3,053
10	2,212	639	2,851
12	1,606	475	2,081
14	1,367	365	1,732
16	780	196	976
18	409	98	507
20+	373	98	471
Total	11,211	5,970	17,181

[1]Source: Van Hooser and Chojnacky (1983).

[2]**Trees 5+ inches d.b.h.**: Bole weight = ovendry weight of wood and bark from a 1-foot stump to a 4-inch top diameter, inside bark; top weight = ovendry weight of wood and bark from a 4-inch diameter to tip of tree, plus branch material down to ¼-inch diameter.

Trees less than 5 inches d.b.h.: Total ovendry weight of wood and bark from a 1-foot stump to tip of tree, plus branch material down to ¼-inch diameter (tabulated under "Top").

ASHLEY NATIONAL FOREST

Area Name and Location—The Alma Taylor area (figs. 6-1, 6-2, and 6-3), which lies at an elevation of 8,600 to 9,400 feet at latitude 40°38' and longitude 109°41', is in the Vernal Ranger District of the Ashley National Forest; the Ranger Station is in Vernal.

The gross area of 16,000 acres includes about 14,500 acres of lodgepole pine timber type and falls entirely within Uintah County; Vernal is the county seat. The area is centered around Alma Taylor Lake (fig. 6-2) and is 24 air miles due south of the town of Manila on the Wyoming border. It lies 15 air miles northwest of Vernal on a heading of 330°.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Taylor Mountain and Dry Fork.

Access—From Vernal (5,050 feet in elevation), a paved road leads 21 miles northwest to the forest boundary along Dry Fork of Ashley Creek; all but the last 2 miles are plowed in winter. From the forest boundary it is 10 miles to the area boundary—the first eight gravel and the last two dirt. At this point a dirt access road leads into the area, southeast toward Alma Taylor Lake (figs. 6-2 and 6-4). From this intersection the dirt Red Cloud Loop Road (not plowed in winter) extends about 28 miles north along the west border of the area and beyond, and then east to intersection with U.S Highway No. 191; an additional 20 miles south along the paved highway closes the loop to Vernal.

Via U.S. Highway No. 191, it is 107 miles north from Vernal to the railhead town of Rock Springs, WY. To the west via U.S. Highway No. 40, and 142 miles distant from Vernal, is a railhead near Park City, UT.

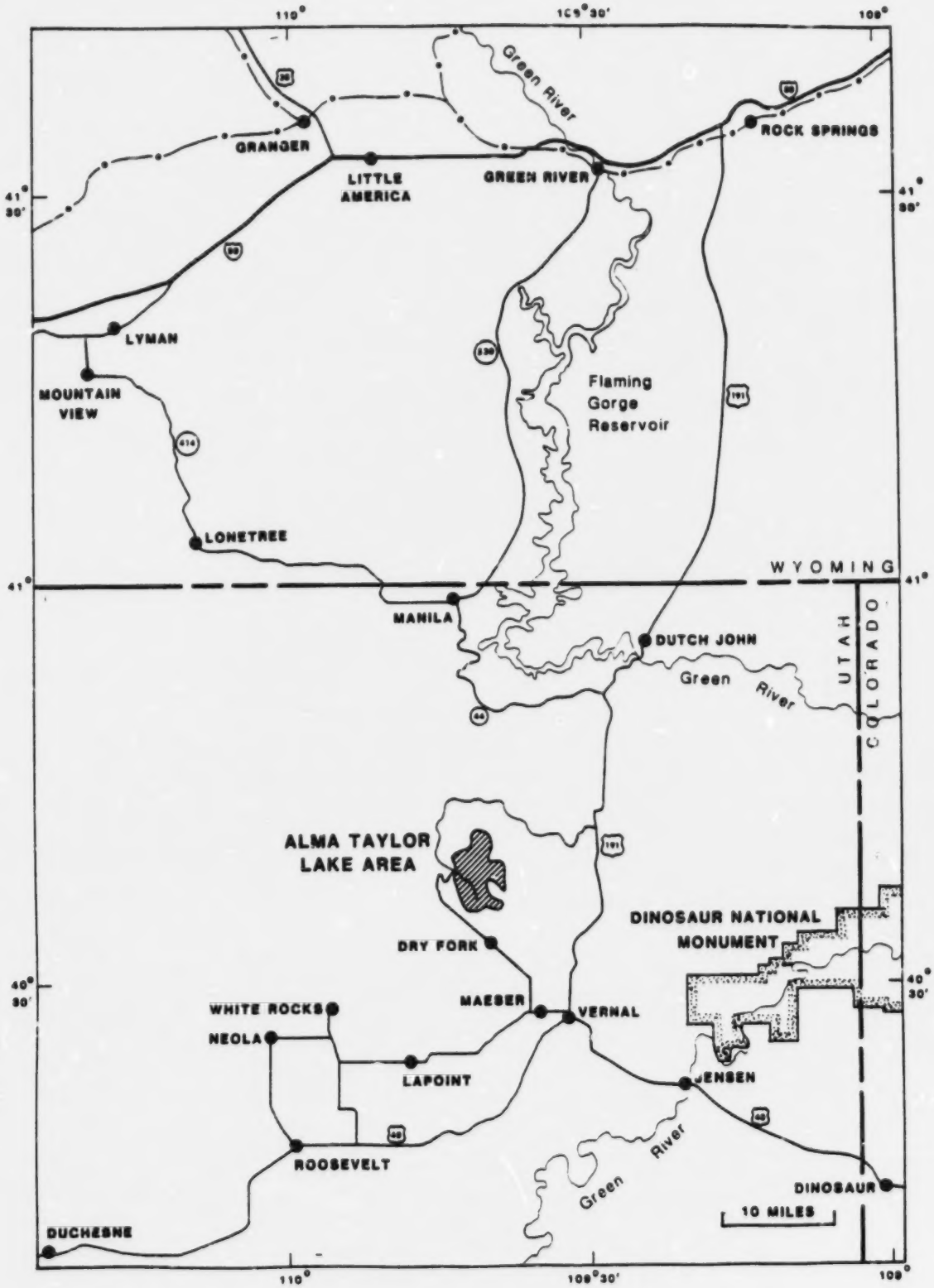

Figure 6-1—Vicinity map for the Alma Taylor area of Ashley National Forest in Utah.

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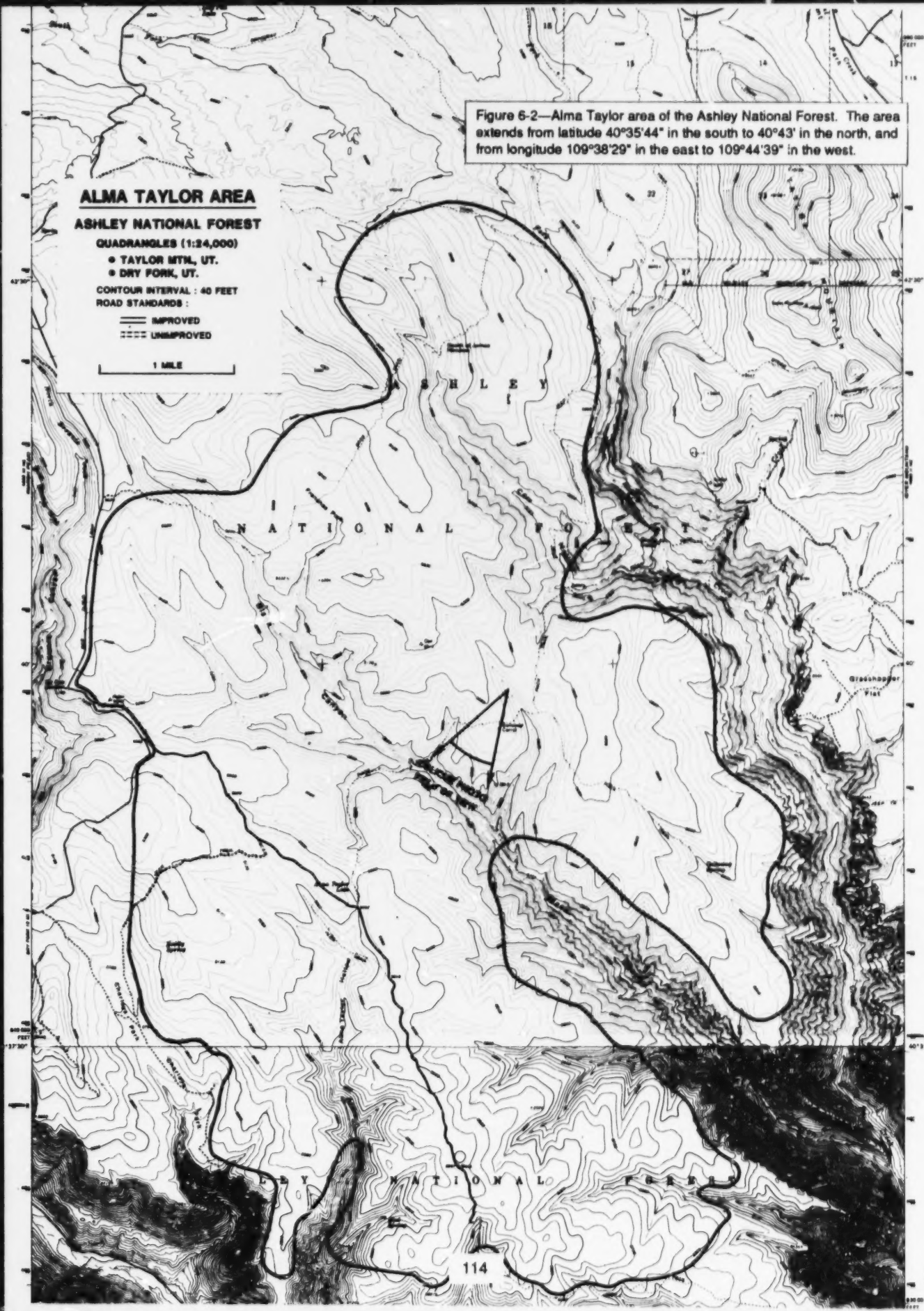
ALMA TAYLOR AREA
ASHLEY NATIONAL FOREST
QUADRANGLES (1:24,000)
• TAYLOR MTN., UT.
• DRY FORK, UT.
CONTOUR INTERVAL : 40 FEET
ROAD STANDARDS :
IMPROVED
UNIMPROVED
1 MILE
A S H L E Y
N A T I O N A L F O R E S T
L O Y A L N A T I O N A L F O R E S T

Figure 6-2—Alma Taylor area of the Ashley National Forest. The area extends from latitude 40°35'44" in the south to 40°43' in the north, and from longitude 109°38'29" in the east to 109°44'39" in the west.

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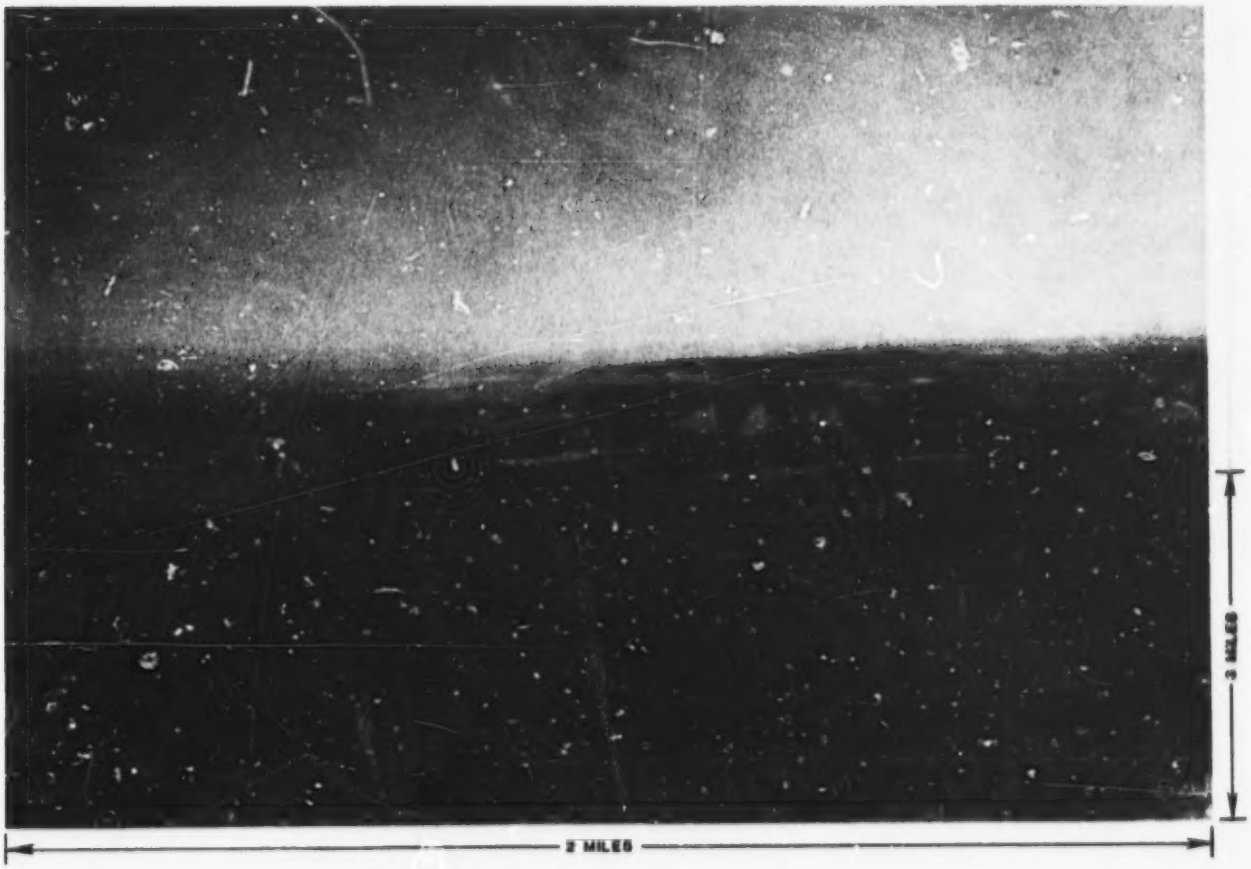

Figure 6-3—Oblique view of the Alma Taylor area looking southwest toward Alma Taylor Lake and Charleys Park. See figure 6-2 for camera viewpoint and field. Width of foreground shown is about 2 miles; from foreground to Charleys Park in the background is about 3 miles.

Figure 6-4—Looking southeast on access road into the Alma Taylor area of the Ashley National Forest from midway along the west border of the area about 2 miles southeast of Dry Fork Overlook; elevation is 9,000 feet.

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Highway distance from Vernal to Salt Lake is 171 miles, and to Denver 325 miles. For highway distances from Park City, UT, to various market centers in the United States, see table 1-2; also, under the Bridger-Teton National Forest in table 1-2, mileages from Rock Springs, WY, are shown.

Terrain and Soil—As previously noted, the area lies between 8,600 and 9,400 feet elevation, with about nine-tenths of the area having slopes less than 45 percent. Along the access road from near Dry Fork Overlook to Alma Taylor Lake, the soil has few rocks exposed and is covered by an inch or two of duff (fig. 6-5). Farther east, however, pumpkin-size rocks are extensively distributed on the surface (fig. 6-6). Aside from the scattered rocks, there appear to be no special obstacles to harvesting.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals about 25 inches per year. The snow-free season generally extends from mid-June to mid-November.

General Character of the Timber—The timber within the area is primarily subsawlog size. Stands are dense (figs. 6-4, 6-5, and 6-6) and mostly of uniform age (about 80 years). Within the delineated area, mortality from mountain pine beetle is not striking, but outside the area mortality is extensive. Many stands in the area are infested with dwarf mistletoe, but damage from rusts and porcupines is not much in evidence.

Harvesting activity north and east of the delineated area has increased in the last few years, and plans call for a continuation of the increased harvest in the future. Within the delineated area there has been little demand for the stumpage, and hence little harvesting.

Data on Sample Trees—A pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. were destructively sampled from level terrain at 9,000 feet elevation about 1 mile northwest of Alma Taylor Lake (fig. 6-5). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.97	3.86
Tree height above 6-inch high stump, feet	41.0	36.5
Crown ratio, percent	32.9	34.3
Cone serotiny	closed	closed
Tree age years (number of annual growth rings)		
Stump height	83	85
20 percent of tree height	79	72
Base of live crown	35	38
Diameter inside bark, inches		
Stump height	4.02	3.90
20 percent of tree height	3.49	3.47
Base of live crown	2.31	2.32
Height from stump top to base of crown, inches	330	288

Figure 6-5—Pair of codominant sample lodgepole pines 3½ to 4 inches in d.b.h. at 9,000 feet elevation, about 1 mile northwest of Alma Taylor Lake in the Ashley National Forest.

Figure 6-6—Rock-strewn forest floor typical of some lodgepole stands in the Alma Taylor area of the Ashley National Forest.

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Characteristic	Tree number 1	Tree number 2
Stem taper inside bark, inches/100 inches		
Below crown	0.52	0.55
Within crown	1.43	1.55
Rings/inch, average for section		
Stump height	41	44
Base of live crown	30	33
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	100.0	110.1
Specific gravity, ovendry weight and green volume	0.369	0.365
Rings/inch in first 1¼ inches radius	46	24
Maximum compresssive strength, lb f/in²	5,060	5,190
Proportional limit, lb f/in²	2,810	3,950
Modulus of elasticity, lb f/in²	1,060,000	970,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	1	3
Bark thickness (single), inch	0.11	0.10
Pith eccentricity, inch	0.2	0.1

Inventory Data—Inventory data on the area are incomplete. As previously mentioned, most of the stands within the delineated area contain subsawlog-size trees. Of the 14,500 acres of lodgepole pine timber type, approximately 80 percent of the acreage resembles stands depicted in figures 6-5 and 6-6. Managers familiar with the area suggest that diameter distribution on such acreage averages about as follows:

D.b.h. class *Inches*	Number of live trees per acre
<2.9	500
3.0-3.9	350
4.0-4.9	300
5.0-5.9	200
6.0-6.9	150
7.0-7.9	20
8.0-8.9	10
9.0+	10
Total	1,540

Cubic Yield Potential and Height Growth—Although data are not well documented, area managers estimate that the current lodgepole pine forests in the delineated area are growing at 20 to 25 ft³ per acre per year; the potential in managed stands is estimated at 50 ft³ per acre per year. Fifty-year height growth in managed stands is estimated to be 30 to 35 feet.

Management Objectives for the Area and Constraints—Because of stagnant stand growth and heavy mountain pine beetle attacks in adjacent stands, a primary management objective is phased harvest and replacement with vigorous, new, controlled-density lodgepole pine stands less susceptible to attack. The harvests must be timed to enhance wildlife habitat and protect watershed and recreational values.

The major deterrent is lack of stumpage markets. Stumpage for firewood (not a large market) sells for about $5 per cord. On acreages within the area that have sawlog-size timber, stumpage might sell for $1 to $12 per M bd ft Scribner scale—a price that does not completely cover the total cost of preparing small-acreage, low-volume sales.

Road costs are unexpectedly higher because road cuts are not called for on level ground typical of the area. Therefore gravel fill must be hauled in.

Other Lodgepole Pine Available in the Area From Public Lands—On the entire Ashley National Forest there are about 240,000 acres of lodgepole pine timber type (including the 14,500 acres within the Alma Taylor area). Of this total, the Forest Plan calls for stand replacement on about 1,100 acres per year in addition to 1,000 to 1,500 acres per year scheduled for harvest through conventional timber sales. A high proportion of the acres scheduled for stand replacement or harvest are on slopes less than 45 percent.

Forest Products Industry in the Vicinity—Within a few miles of Vernal there are two small sawmills cutting 1 or 2 million bd ft annually, and another very small mill in Neola west of Vernal. Somewhat larger sawmills operate in Lapoint (also west of Vernal), and in Mountain View, northwest of Manila near I-80.

Producers of roundwood products operate in Manila and in Lapoint, the latter making house logs. There is no market for pulp chips within economic haul distance.

Population in the Vicinity—In 1980 Uintah County had a total population of 20,506. Vernal, the county seat, has a population (1986) of about 6,600. In 1985 the per-capita income in Uintah County was $8,984, with 3.5 percent of the workforce unemployed.

REFERENCES

Van Hooser, Dwane D.; Chojnacky, David C. 1983. Whole tree volume estimates for the Rocky Mountain States. Resour. Bull. INT-29. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 69 p.

Van Hooser, Dwane D.; Green, Alan W. 1983. Utah's forest resources, 1978. Resour. Bull. INT-30. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 58 p.

CHAPTER 7: WASHINGTON

INTRODUCTION

In Washington, lodgepole pine predominates on about 770,000 acres of the State's 17.4 million acres of commercial forest land, with about 1.8 billion ft³ of lodgepole pine growing stock and 5.2 billion bd ft of sawtimber (table 7-1). Approximately 3 percent of the softwood growing stock and 2 percent of the softwood sawtimber in the State is lodgepole pine (Bassett and Oswald 1981a, 1981b, 1982, 1983).

Approximately 42 percent of the lodgepole pine growing stock in Washington is in trees smaller than the 10-inch d.b.h. class (table 7-2).

Managers of public forest land in Washington selected for study four areas (fig. 7-1) totaling 133,120 acres in gross area. The study areas are individually described in the following text.

Table 7-1—Volume of lodgepole pine growing stock and sawtimber, and acreage in lodgepole pine, by ownership class, Washington[1]

Ownership class	Growing stock[2]	Sawtimber volume[3]	Commercial timberland area[4]
	Million ft³	*Million bd ft International 1/4-inch scale*	*Thousand acres*
National Forest (commercial)[4]	769	1,914	411
Other public	545	1,847	190
Forest industry	165	618	43
Other private	280	807	128
Total	1,759	5,186	772

[1]Sources: Bassett and Oswald (1981a, 1981b, 1982, 1983).
[2]**Growing stock volume** = net volume in cubic feet of live sawtimber and pole timber trees (5 inches d.b.h. and larger) from stump to a minimum 4-inch top outside bark, or to the point where the central stem breaks into limbs.
[3]**Sawtimber volume** = net volume in board feet of the sawlog portion of live sawtimber trees. Sawtimber trees are live trees of commercial species, 9 inches in d.b.h. or larger (softwood), containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect.
[4]**Commercial timberland** = forest land that is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. Areas qualifying as commercial timberland have the capability of producing in excess of 20 ft³ per acre per year of industrial wood in natural stands.

Table 7-2—Distribution of lodgepole pine growing stock cubic volume by diameter class—Washington[1]

Diameter class	Volume of growing stock[2]		
	Eastern Washington[3]	Western Washington[3]	Total
Inches	*Million ft³*		
6	264	14	278
8	440	24	464
10	326	27	353
12	227	34	261
14	139	22	161
16	80	17	97
18	55	13	68
20	37	2	39
22-28	27	4	31
29+	6	—	6
Total	1,601	157	1,758

[1]Sources: Bassett and Oswald (1981a, 1981b, 1982, 1983).
[2]**Growing stock volume** = net volume in cubic feet of live sawtimber and pole timber trees (5 inches d.b.h. and larger) from stump to a minimum 4-inch top outside bark, or to the point where the central stem breaks into limbs.
[3]Eastern Washington = area east of crest of Cascade Range; western Washington = area west of crest of Cascade Range.

COLVILLE NATIONAL FOREST

Area Name and Location—The Pend Oreille-Ruby Creek area (figs. 7-2, 7-3, and 7-4), which lies at an elevation of 2,800 to 5,200 feet at latitude 48°35' and longitude 117°26', is in three Ranger Districts (Newport, 5,000 acres; Colville, 15,000 acres; and Sullivan Lake, 20,000 acres) of the Colville National Forest. The Newport Ranger Station is in Newport, which is also the county seat of Pend Oreille County in which the entire area is located.

The gross area of about 40,000 acres includes about 14,000 acres on which lodgepole pine predominates, and 16,000 acres of lodgepole pine mixed with western larch; on the balance of the acreage, larch predominates. The area is centered around Ruby Creek and the south fork of Lost Creek (fig. 7-3). The center of the southern end of the area is 21 air miles due east of Colville. The north border of the area is 7 air miles due south of Ione. At closest proximity, the Pend Oreille River passes within 1 mile of the eastern border of the area.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Aladdin Mountain, Ione, Lake Gillette, and Timber Mountain.

WASHINGTON

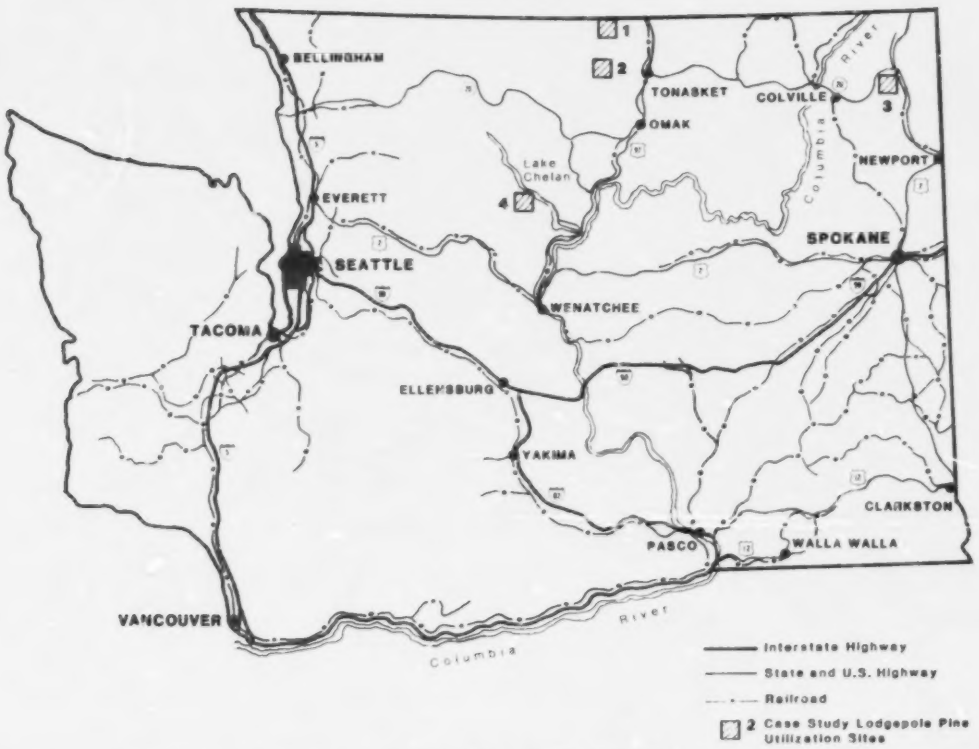

Figure 7-1—Washington location map. 1. State Forest (Loomis Block) 2,120 acres. 2. Okanogan NF (Meadows) 89,000 acres. 3. Colville NF (Pend Oreille-Ruby Creek) 40,000 acres. 4. Wenatchee NF (Big Creek-Lake Creek) 2,000 acres.

Access—From Blue Slide, WA (2,060 feet in elevation and about 38 miles northwest of Newport via State Highway No. 20), an improved road leads west up Ruby Creek 3½ miles to the east border of the area and on west to the confluence of Little Ruby Creek and Ruby Creek. From this point a gravel road leads north to Rufus Meadows, which lies at an elevation of 4,100 feet; road distance from Rufus Meadows to Newport is 50 miles. Farther west within the area, a gravel road (Tacoma Divide Road) runs north the full length of the area, connecting with State Highway No. 20 just north of the Little Pend Oreille River. Also, there is road access to the southeast quadrant of the area, and to the east-central portion (fig. 7-3).

The nearest railhead is at Blue Slide (or possibly Cusick, which is 18 miles northwest of Newport) on the Pend Oreille Valley line from Metaline Falls to Newport. For highway distances from Cusick to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 2,800 and 5,200 feet elevation, with about two-thirds of the acreage having slopes in excess of 25 percent; about 10 percent of the acres have slopes of more than 45 percent, but none exceed 55 percent.

In most areas glacial till soils are overlayed with 16 to 28 inches of volcanic ash. Along Ruby Creek deep sands are encountered.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals 35 to 40 inches, with most falling as snow. The snow-free season generally extends from late May through October.

General Character of the Timber—The timber is characterized by an overstory of 300 to 550 lodgepole pine and/or larch trees per acre measuring 4 to 6 inches in d.b.h., and a several-thousand-stem per acre understory of mixed conifers measuring about 2 inches in d.b.h. (figs. 7-5 and 7-6). The overstory is 50 to 60 feet high and the understory 6 to 24 feet high. Overstory trees average about 65 years old.

Currently, mountain pine beetle attacks are minor, as are attacks by western gall rust. Porcupine damage is

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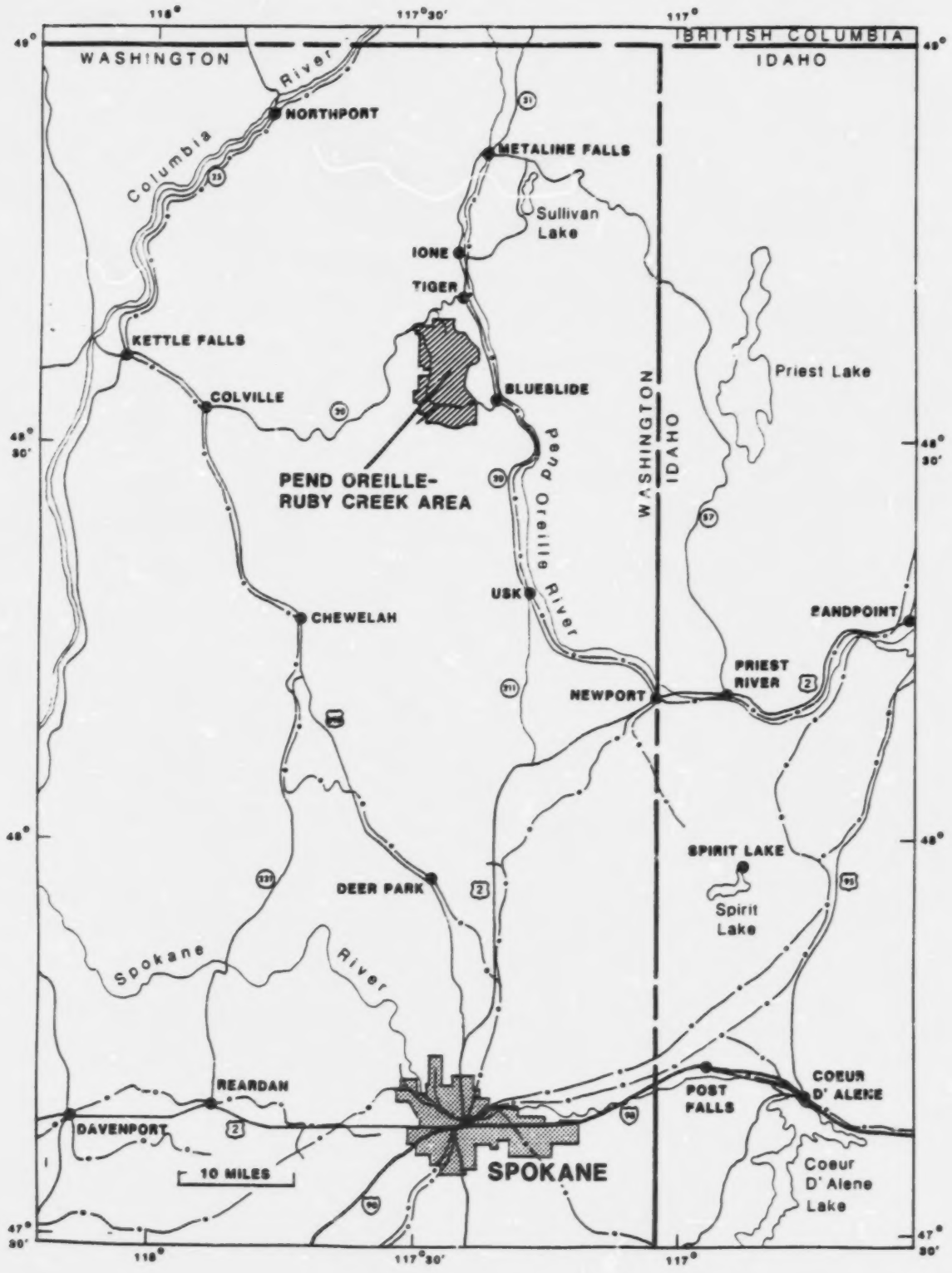

Figure 7-2—Vicinity map for the Pend Oreille-Ruby Creek area of the Colville National Forest in Washington.

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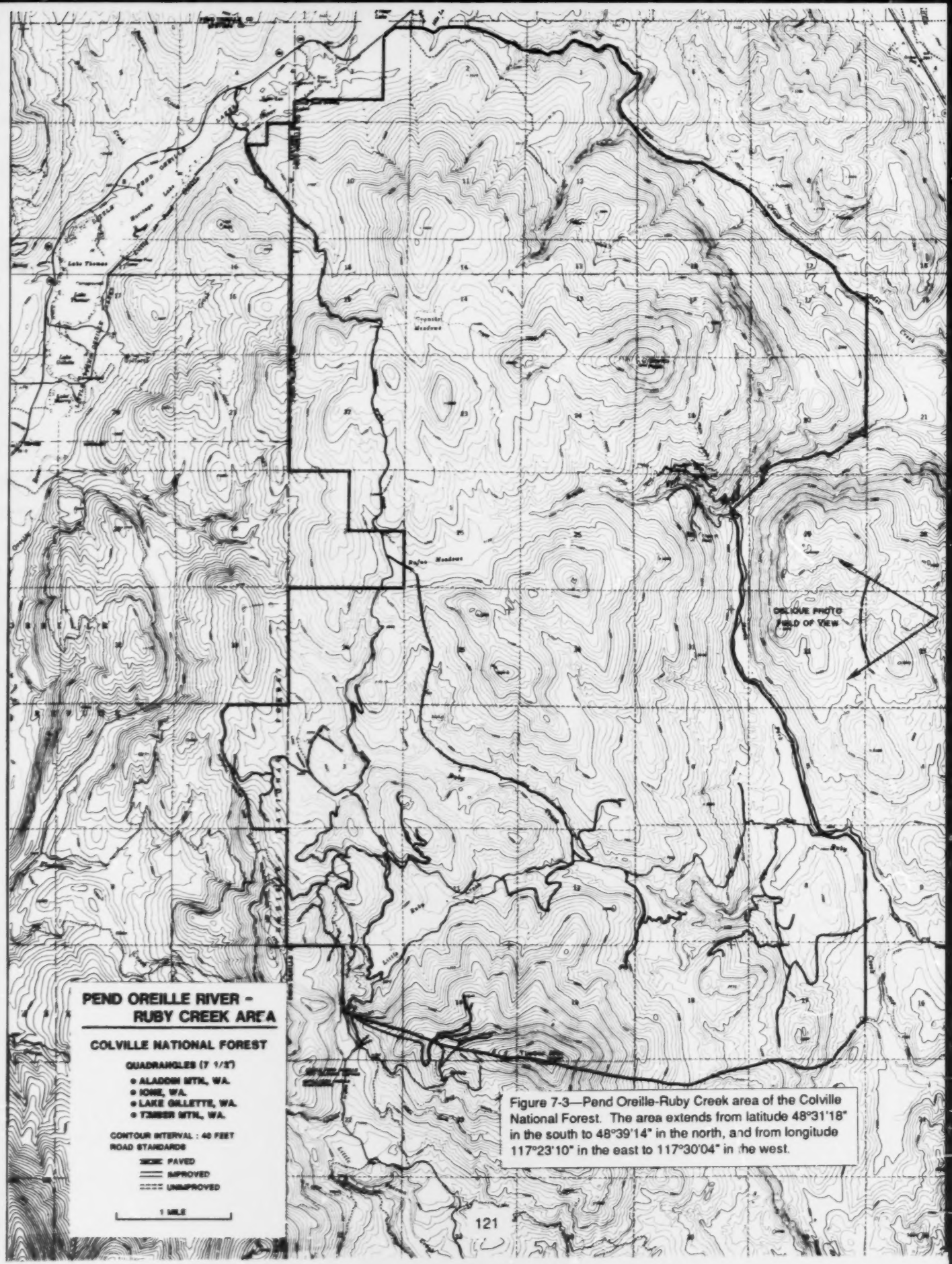

Figure 7-3—Pend Oreille-Ruby Creek area of the Colville National Forest. The area extends from latitude 48°31'18" in the south to 48°39'14" in the north, and from longitude 117°23'10" in the east to 117°30'04" in the west.

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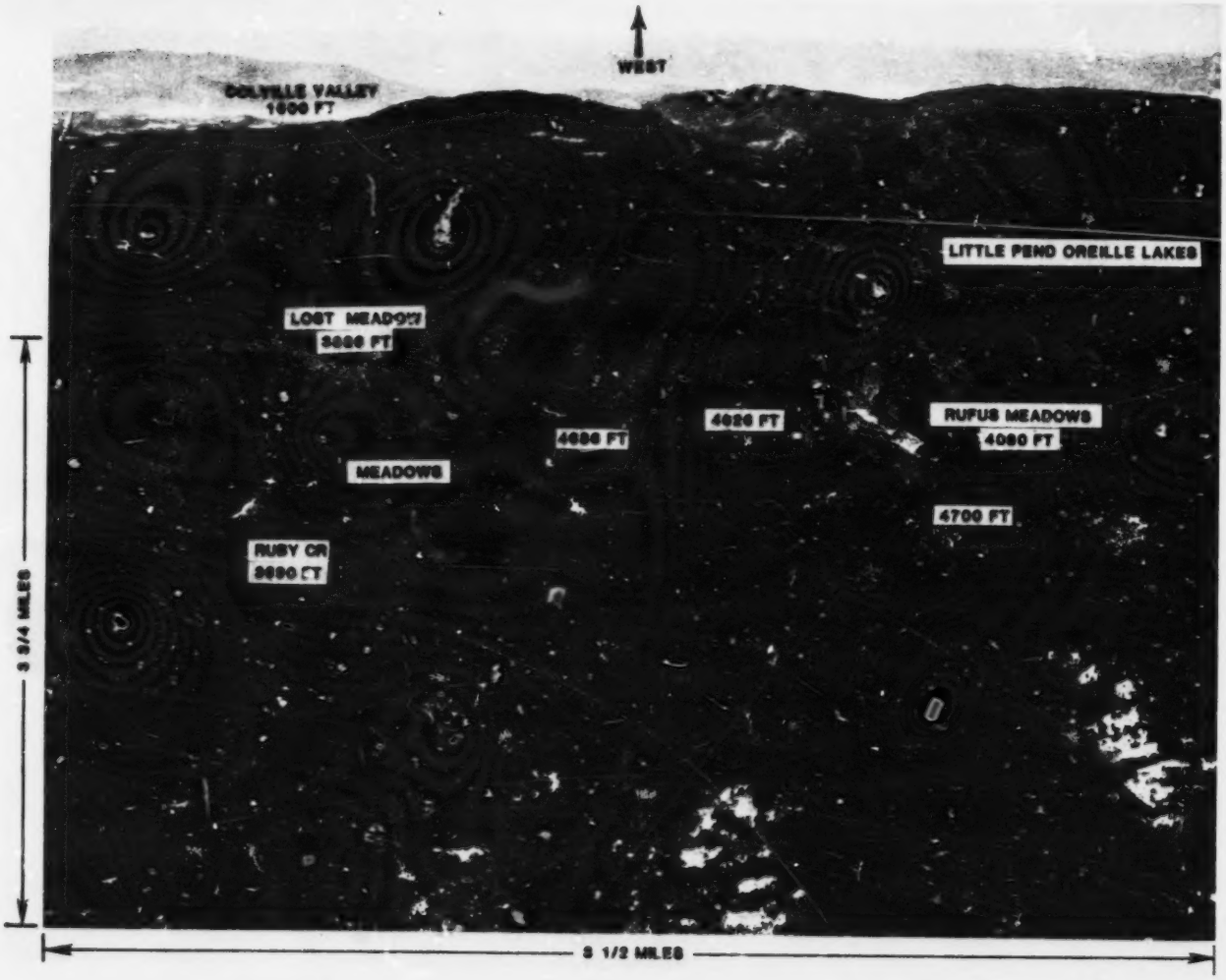

Figure 7-4—Oblique view of the Pend Oreille-Ruby Creek area looking west across it toward the Colville Valley and the Little Pend Oreille Lakes. See figure 7-3 for camera viewpoint and field. Width of foreground shown is about 3 ½ miles; from the foreground to the west border of the area by Lost Meadow is about 3¾ miles.

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Figure 7-5—Lodgepole pine overstory and mixed-conifer understory along access road between Rufus Meadows and the confluence of Ruby Creek and Little Ruby Creek in the Colville National Forest, at elevation of 3,600 feet.

Figure 7-6—Mixed-conifer dense understory below an overstory of lodgepole pine and larch south of Rufus Meadows in the Colville National Forest.

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slight, and dwarf mistletoe infestation is not a serious problem. Willow growth can stifle seedlings if harvested areas are not promptly regenerated and vegetation managed.

In years past, about 1,000 acres have been harvested for pulpwood and small sawlogs. Currently, about 100 acres are harvested annually for these products.

Data on Sample Trees—A pair of adjacent lodgepole pines (and a nearby larch) measuring 3½ to 4 inches in d.b.h. were destructively sampled from the edge of a stand about a mile south of Rufus Meadows at about 4,000 feet elevation.

The larch was 44 years old at the stump, 37 feet tall, and 4 inches in d.b.h., with stemwood moisture content and specific gravity at 20 percent of tree height measuring 86.6 percent of ovendry weight and 0.443 (based on ovendry weight and green volume), respectively. Its crown ratio was 55.9 percent and it had inside-bark stem taper below the crown of 0.56 inch per 100 inches. A pith-centered 2¼-inch-diameter dowel turned from a 9-inch-long stem section taken at 20 percent of tree height had modulus of elasticity of 1,480,000 lb f/in² and maximum crushing strength parallel to the grain of 6,900 lb f/in² (both values adjusted to a specimen moisture content of 10 percent).

Some pertinent characteristics of the lodgepole pine trees sampled follow. These tabulated data should not be interpreted as representative of all the overstory trees, particularly because these two were sampled at the edge of a stand where they had little competition and grew more rapidly than more characteristic overstory trees within stands.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.80	3.50
Tree height above 6-inch high stump, feet	34.3	33.7
Crown ratio, percent	70.1	62.1
Cone serotiny	open	open
Tree age years (number of annual growth rings)		
Stump height	24	29
20 percent of tree height	16	19
Base of live crown	12	16
Diameter inside bark, inches		
Stump height	3.82	3.35
20 percent of tree height	3.75	3.08
Base of live crown	3.01	2.78
Height from stump top to base of crown, inches	123	153
Stem taper inside bark, inches/100 inches		
Below crown	0.66	0.37
Within crown	1.05	1.20
Rings/inch, average for section		
Stump height	13	17
Base of live crown	8	12
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	157.6	133.0
Specific gravity, ovendry weight and green volume	0.359	0.387
Rings/inch in first 1¼ inches radius	10	13
Maximum crushing strength, lb f/in²	4,280	5,350
Proportional limit, lb f/in²	3,110	4,110
Modulus of elasticity, lb f/in²	960,000	1,130,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	0	0
Bark thickness (single), inch	0.12	0.14
Pith eccentricity, inch	0.1	0.2

Inventory Data—Inventory data on the area are minimal. See comments under the paragraph heading "General Character of the Timber."

Cubic Yield Potential and Height Growth—Although data are not well documented, managers responsible for the area estimate that lodgepole pines in managed stands should average 1 inch of radius growth per decade, and grow 50 to 120 ft³ of stemwood per acre per year. Fifty-year height growth in managed stands is estimated to be 60 to 80 feet.

Management Objectives for the Area and Constraints—The area has the potential for relatively high productivity if brought under management. The primary objective, therefore, is phased harvest of both understory and overstory and replacement with vigorous, new, controlled-density stands containing a mixture of coniferous species—including lodgepole pine—with intention of establishing a rotation of about 70 years. If properly timed, such harvests can enhance wildlife habitat and protect watershed values.

The obstacle to achieving the objectives is inability to market the stumpage at a price sufficient to pay the costs of stand replacement. In the absence of harvest, the forest managers have experimented with a number of ways of destroying the stands and replacing them as described above. On slopes amenable to mobile machinery, significant acreage has been trampled without prior harvest, burned to kill advanced regeneration and to prepare the site for planting, and hand-planted with bare-root seedlings comprising a mixture of coniferous species (fig. 7-7). As funds are available, additional acreages will be so treated in the future.

Such machine trampling is not possible, however, on those portions of the area that have slopes in excess of about 25 percent.

Other Lodgepole Pine Available in the Area From Public Lands—On the entire Colville National Forest there are an additional 160,000 acres of more-or-less stagnated lodgepole pine for which the managers have no present substantial market at a stumpage price adequate to pay for stand replacement.

Figure 7-7—Acreage south of Rufus Meadows in the Colville National Forest on which, without prior harvest, the stagnated stand has been trampled, burned, and hand-planted with bare-root seedlings. A seedling is visible in the center of the photo.

Forest Products Industry in the Vicinity—In Ione, just north of the area, there is a sizable sawmill cutting random-length dimension lumber from a variety of species. To the south, in Usk, there is a plant producing lodgepole pine pulp chips—and also near Usk, a facility to manufacture thermomechanical newsprint is under construction. A sawmill (presently closed) capable of cutting metric sizes of lumber is located in Newport. Also, there is a post-and-pole plant in Newport. Farther east, large sawmills cutting dimension lumber are located in Priest River and Sandpoint, ID.

To the west there is a plywood plant and a chip-fired power plant in Kettle Falls. And several large sawmills are located in the Colville-Addy-Chewelah vicinity. Few, if any, of these sawmills have use for subsawlog-size lodgepole pine. The pulp plant will, however.

House log manufacturers are located just west of Newport and in Priest River. A Spokane plant manufactures newsprint, but not from lodgepole pine.

Population in the Vicinity—The total population of Pend Oreille County was 9,100 in 1984. Newport, the county seat, has a population of 1,500. The settlements of Cusick and Blue Slide, both along the railroad east of the area, have populations of only a few.

Per-capita income in Pend Oreille County averaged $6,959 in 1981. During 1985, 15.3 percent of those in the workforce were unemployed.

OKANOGAN NATIONAL FOREST

Area Name and Location—The Meadows area (figs. 7-8, 7-9, and 7-10), which lies at an elevation of 4,500 to 8,242 feet at latitude 48°42' and longitude 119°57', is in the Tonasket and Winthrop Ranger Districts of the Okanogan National Forest; the Ranger Stations are in Tonasket and Winthrop, respectively.

The gross area of about 89,000 acres is about 81 percent timbered, and includes about 48,000 acres of lodgepole pine timber type. It lies entirely within Okanogan County; the town of Okanogan is the county seat. The area extends north and south between Long Swamp Campground in the north and Granite Mountain in the south (fig. 7-9). The north edge of the area lies 6 air miles south of the Canadian border, and about 14 miles due west of Palmer Lake. The town of Loomis is 14 air miles due east of the middle of the north half of the area, and Conconully is 10 miles due east of the center of the south end of the area.

Maps of the Area—USGS quadrangle maps (all metric) needed to depict the area are: Robinson Mountain, Oroville, Twisp, and Omak.

Access—A paved road runs 21 miles west from Loomis (1,310 feet) to Long Swamp Campground (about 5,500 feet). From Long Swamp Campground a gravel road extends south through most of the length of the area, connects with an improved road to Conconully (fig. 7-9), and hence to Omak and Tonasket (903 feet) on the Okanogan River. Tonasket is about 18 miles southeast of Loomis, and 24 miles north of Omak.

Omak, on the Burlington Northern line from Oroville to Wenatchee, is a nearby railhead. For highway distances from Omak to various market centers in the United States, see table 1-2.

Terrain and Soil—The timbered area lies primarily between 4,500 feet and 7,000 feet, with two-thirds of the area having slopes less than 36 percent. Soils are of granitic origin and do not have the volcanic ash overlay common on the Colville National Forest to the east. The ground does not appear excessively stony or rocky (figs. 7-10 and 7-11), and there appear to be no special obstacles to harvesting.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation averages 40 to 45 inches, with heavy snow accumulation usual in winter. The snow-free season generally extends from June 1 to mid-September.

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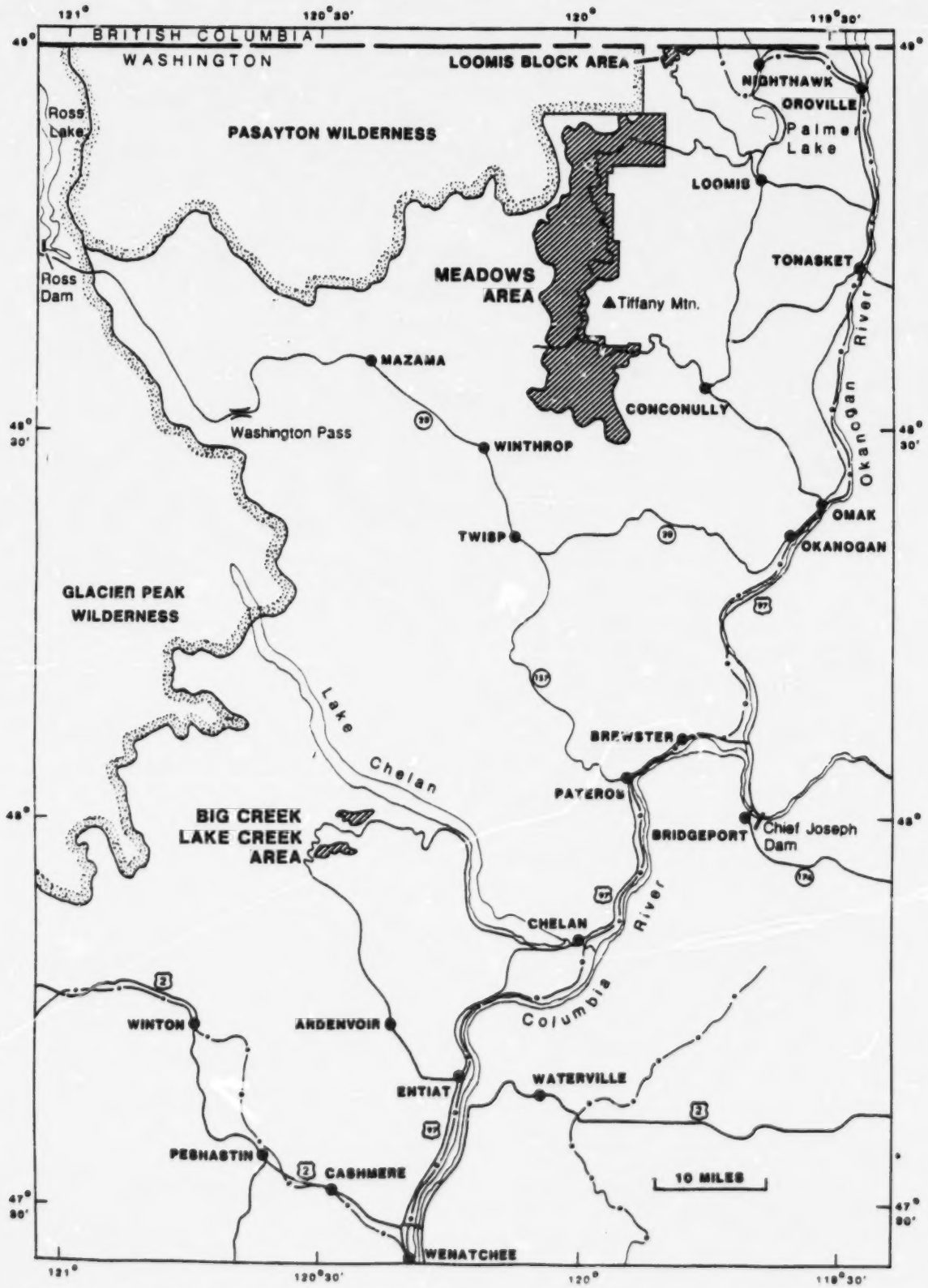

Figure 7-8—Vicinity map for the Meadows area of the Okanogan National Forest, the Loomis Block area of the State Forest, and the Big Creek-Lake Creek area of the Wenatchee National Forest—all in Washington.

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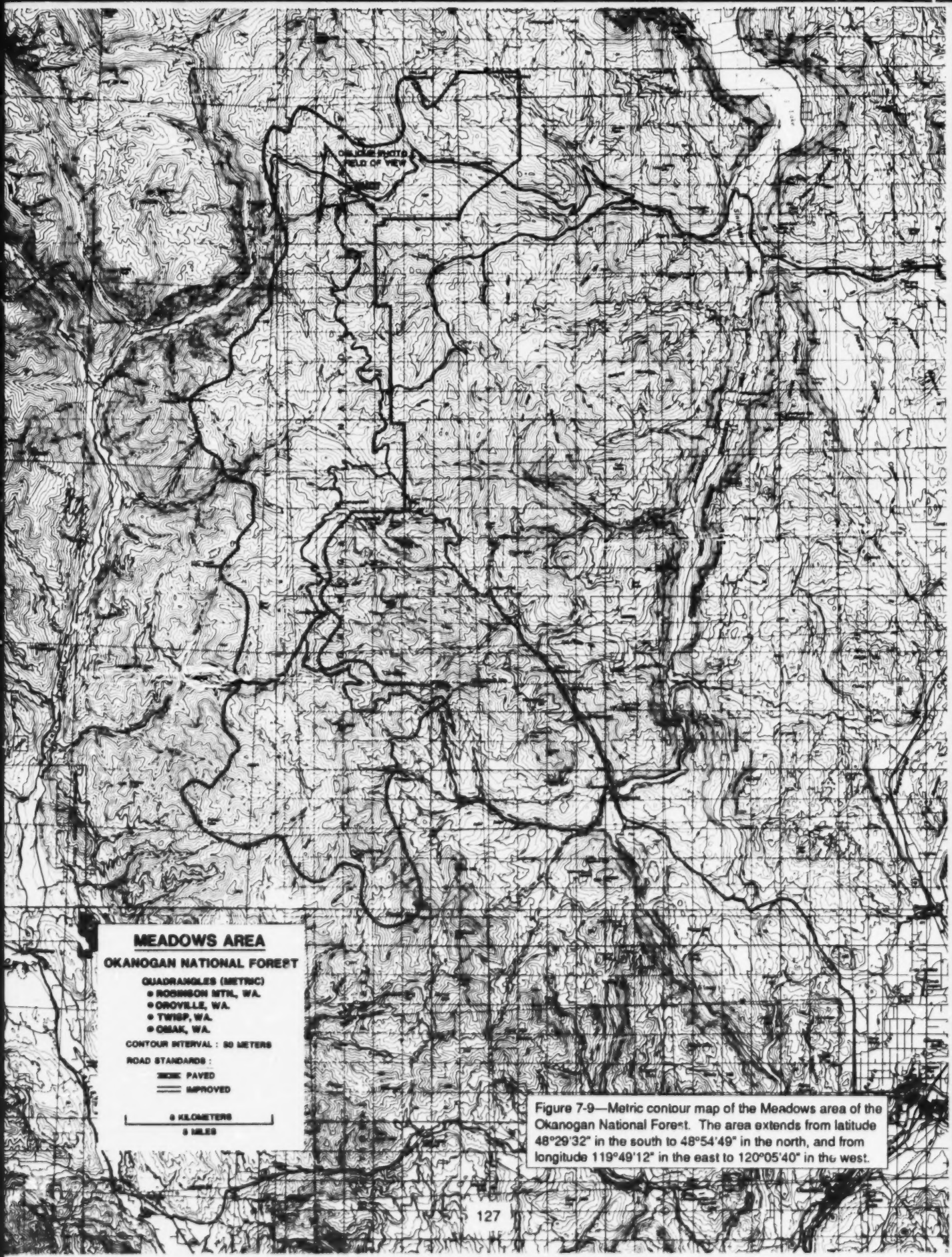

Figure 7-9—Metric contour map of the Meadows area of the Okanogan National Forest. The area extends from latitude 48°29'32" in the south to 48°54'49" in the north, and from longitude 119°49'12" in the east to 120°05'40" in the west.

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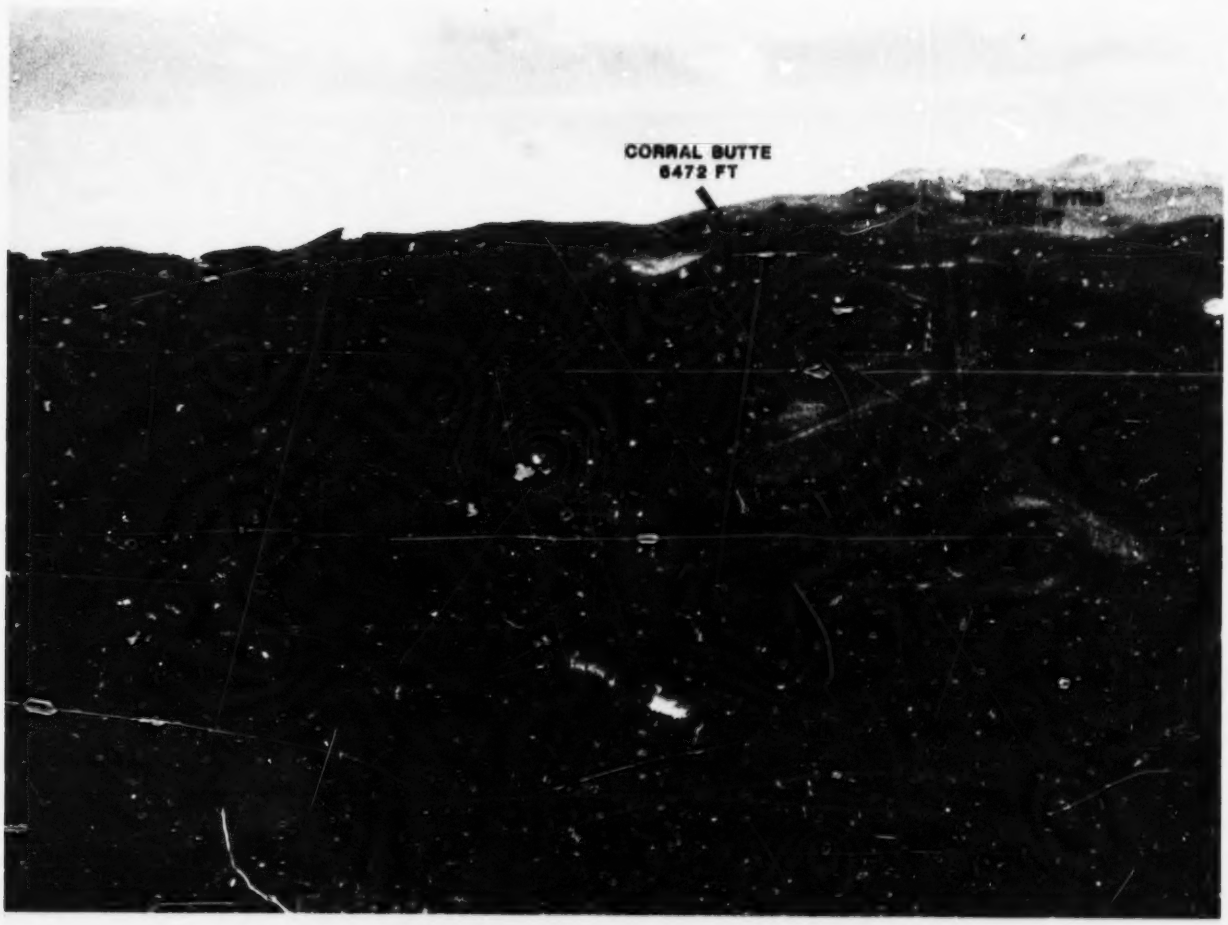

Figure 7-10—Oblique view of the Meadows area of the Okanogan National Forest looking south from near the north border of the area. See figure 7-9 for camera viewpoint and field. Width of foreground shown is about 1½ miles; from the foreground to low background (Corral Butte) is about 3 miles. The Tiffany Mountains on the skyline are about 13 miles distant.

General Character of the Timber—Acreage by forest type on the area is as follows:

Lodgepole pine		
Mature/small sawtimber (including much pole material)	26,870	
Pole timber	11,800	
Seedlings and saplings	8,500	
Total lodgepole type		47,170
Mixed conifer and other (including significant lodgepole volume)		24,920
Noncommercial and nonforest		16,910
Total acres		89,000

As is usually the case, the lodgepole timber varies in a continuum from one stand to another (figs. 7-11 and 7-12), with diameters mostly less than 9 inches. In the north portion of the area stands are mostly of sapling and pole size, whereas in the south there are significant acreages of small sawlogs carrying about 8,000 bd ft per acre Scribner scale.

Some portions were burned 90 to 100 years ago, and on those acreages not burned in this fire the trees are about 200 years old.

Mortality from mountain pine beetles is not currently evident, but managers predict significant beetle attacks within 5 to 10 years. Rust-caused cankers are not evident, and there is little damage from porcupines. A significant number of live trees have forked stems, and stems of down timber display more-than-usual spiral grain, however (fig. 7-13).

Data on Sample Trees—To provide more than casual observational data descriptive of the trees, a pair of adjacent codominant lodgepole pines 3½ to 4 inches in d.b.h. were destructively sampled from gently sloping terrain at 6,250 feet about 1½ miles north of Corral Butte. Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

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Figure 7-11—Lodgepole pine pole timber growing with little undergrowth at 6,500 feet just east of Corral Butte in the Meadows area of the Okanogan National Forest. The stadia rod in center foreground has 1-foot markings.

Figure 7-12—Stagnated stand of lodgepole (all less than 3 inches in d.b.h.) between Long Swamp and Corral Butte in the Meadows area of the Okanogan National Forest.

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Figure 7-13—Spiral grain in air-dried pole-size lodgepole stems in the Meadows area of the Okanogan National Forest.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.57	3.82
Tree height above 6-inch high stump, feet	35.3	37.5
Crown ratio, percent	28.3	14.7
Cone serotiny	no observation made	
Tree age years (number of annual growth rings)		
Stump height	100	98
20 percent of tree height	75	64
Base of live crown	37	41
Diameter inside bark, inches		
Stump height	3.77	4.08
20 percent of tree height	3.10	3.36
Base of live crown	1.90	2.41
Height from stump top to base of crown, inches	304	384
Stem taper inside bark, inches/100 inches		
Below crown	0.62	0.43
Within crown	1.58	3.65
Rings/inch, average for section		
Stump height	53	48
Base of live crown	39	34
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	111.3	91.2
Specific gravity, ovendry weight and green volume	0.400	0.466
Rings/inch in first 1¼ inches radius	48	28
Maximum crushing strength, lb f/in²	6,200	7,030
Proportional limit, lb f/in²	3,510	5,270
Modulus of elasticity, lb f/in²	1,470,000	1,710,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	5	2
Bark thickness (single), inch	0.12	0.11
Pith eccentricity, inch	0.1	0.1

Inventory Data—Inventory data on the area are incomplete. As noted previously, the area contains mixed-conifer stands as well as pure lodgepole stands, and the southern portion has some small sawtimber, while the northern portion is mostly in pole stands.

To indicate the diameter distribution in northern-portion stands, summary data on three large areas adjacent to Corral Butte are tabulated below. Stands 1 and 5 are mixed conifer (lodgepole pine, subalpine fir, Engelmann spruce, and Douglas-fir) in which 481 and 586 stems per acre, respectively, are larger than 3 inches in d.b.h. In stand number 2 (almost pure lodgepole) there are 1,081 live stems, of which 643 are larger than 3 inches in d.b.h.

Stand number and type	Total	<3 inches d.b.h.	>7 inches d.b.h.
	- - Number of live trees per acre - -		
1 (620 acres) mixed conifer	1,656	1,175	98
2 (1,108 acres) pure lodgepole	1,081	438	67
5 (1,150 acres) mixed conifer	1,253	667	131

Cubic Yield Potential and Height Growth—Data are not well documented, but managers of the area estimate that current growth is 27 to 58 ft³ of stemwood per acre per year, with most stands in the lower range. In managed stands, growth should be in the range from 35 to 65 ft³ per acre per year. Fifty-year height growth in managed stands is estimated to be 40 feet, possibly less.

Management Objectives for the Area and Constraints—The area is habitat for the lynx (*Lynx canadensis*), and management activities must be designed to protect the lodgepole pines that form the habitat. With this consideration in mind, it is the objective of the managers to accomplish phased harvests of the stagnated stands

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and to replace them with vigorous, young, controlled- density stands of lodgepole pine. If such harvests are timed appropriately, they can enhance wildlife habitat and watershed values and preserve recreational values.

The primary obstacle to management activities is the inability to market small stems from these stagnated stands—even at stumpage prices below $10 per M bd ft Scribner scale.

Other Lodgepole Pine Available in the Area From Public Lands—In addition to the 48,000 acres of lodgepole pine timber type in the Meadows area, the Okanogan National Forest administers about 20,000 acres of lodgepole east of Tonasket. Also, the State Forest of Washington has about 30,000 additional acres of similar lodgepole pine east and west of Tonasket.

Forest Products Industry in the Vicinity—Sawmills manufacturing random-length dimension lumber are located in Oroville, Tonasket vicinity, Republic, and Omak vicinity; the mill in Omak also has a plywood plant. Additionally, there is a large plant near Omak that manufactures pine lumber (mostly ponderosa pine) for furniture. South of Oroville on the Burlington Northern rail line there is a facility for transshipping (reloading) pulp chips en route to plants on the Columbia River west of the Cascades.

Population in the Vicinity—In 1980 the total population of Okanogan County was 30,639, and the town of Okanogan—the county seat—had a population of 2,302. Omak, with a population (1980) of 4,007, is the largest community in the county. Annual per-capita income in 1984 was $10,949 in Okanogan County. During October 1986, 10.4 percent of those in the workforce were unemployed.

WENATCHEE NATIONAL FOREST

Area Name and Location—The Big Creek-Lake Creek area (figs. 7-8, 7-14, and 7-15), which lies at an elevation of 4,000 to 6,200 feet at latitude 47°58' and longitude 120°27', is in the Chelan and Entiat Ranger Districts of the Wenatchee National Forest; the Ranger Stations are in Chelan and Entiat.

The gross delineated area totals about 2,000 acres, all of which are in lodgepole pine timber type except for a few stringers of spruce along stream edges, and falls entirely within Chelan County; Wenatchee is the county seat. The delineated area is in two adjacent, but separate acreages—one on the upper end of the Big Creek drainage, and the other to the south of Lake Creek (figs. 7-14 and 7-15). Junior Point at the east end of the Big Creek acreage is 2½ air miles south of Lake Chelan. The access road (where it passes between the two acreages) is about 24 air miles northwest of Entiat on a heading of 332°, and 22 air miles west-northwest of the town of Chelan on a heading of 295°.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are the following: Silver Falls and Brief.

Access—A paved road runs from Entiat on the Columbia River (elevation 800 feet) for 29 miles up the Entiat River to a junction (at 2,418 feet elevation) with graveled Shady Pass Road running north for 4 miles to a motorbike trail (at 3,900 feet), which leads up the west side of Lake Creek and provides the easiest access into the Lake Creek drainage (fig. 7-16).

Shady Pass Road continues north and east between the two delineated acreages for another 11 miles to its highest point (6,654 feet) adjacent to Junior Point at the eastern extremity of the Big Creek delineated area. From this high point the road drops to Chelan Lake to the north and then follows the lake's southern shoreline to the town of Chelan, 40 miles distant from Junior Point. The elevation of Chelan is 1,000 feet.

Both Entiat and Chelan are on the Burlington Northern rail line connecting Oroville and Wenatchee. For highway distances from Chelan to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 4,000 and 6,200 feet elevation. Because the area has purposely been delineated to include steeper portions of the two drainages, half or more of the area has slopes exceeding 45 percent. Soil is comprised of a several-foot-deep deposition of volcanic ash and pumice. Steepness of terrain and distance from access roads appear to be the major obstacles to harvesting.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals about 40 inches and falls mostly as snow. The snow-free season generally extends from June 1 through October.

General Character of the Timber—Within the 2,000 acres delineated, stands are virtually pure lodgepole, originating from a forest fire near the end of the last century. Most trees are less than 7 inches in d.b.h., and most are 35 to 40 feet tall, with crown ratios of 30 to 40 percent. Dead branch retention is not excessive, but trees appear to have more dead limbs at high elevation than at low.

While stands vary considerably, most are more or less stagnant, with typical acres having 1,000 to 3,000 live stems per acre, of which about 60 percent are 3 inches or larger in d.b.h. Except in occasional small "blow downs," there is not much dead timber on the ground and undergrowth is relatively light. Some lodgepole pines in the area carry serotinous cones, and others carry open cones.

Mountain pine beetles attacked the area in the 1950's, but today mortality from these attacks is not evident. Dwarf mistletoe infestations and stem cankers appear to be minor, and no significant damage from porcupines is evident. Recent widespread forest fires have burned large acreages in all directions from the Big Creek and Lake Creek drainages, but none have entered the upper portions of these drainages for about 100 years.

There has been no harvest activity in the delineated area, but a main haul road is planned to enter the lower elevations of Lake Creek (fig. 7-14).

Data on Sample Trees—A pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. were destructively sampled at an elevation of 4,500 feet from gently sloping terrain just west of Lake Creek and close to the western extremity of the delineated area (fig. 7-17). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

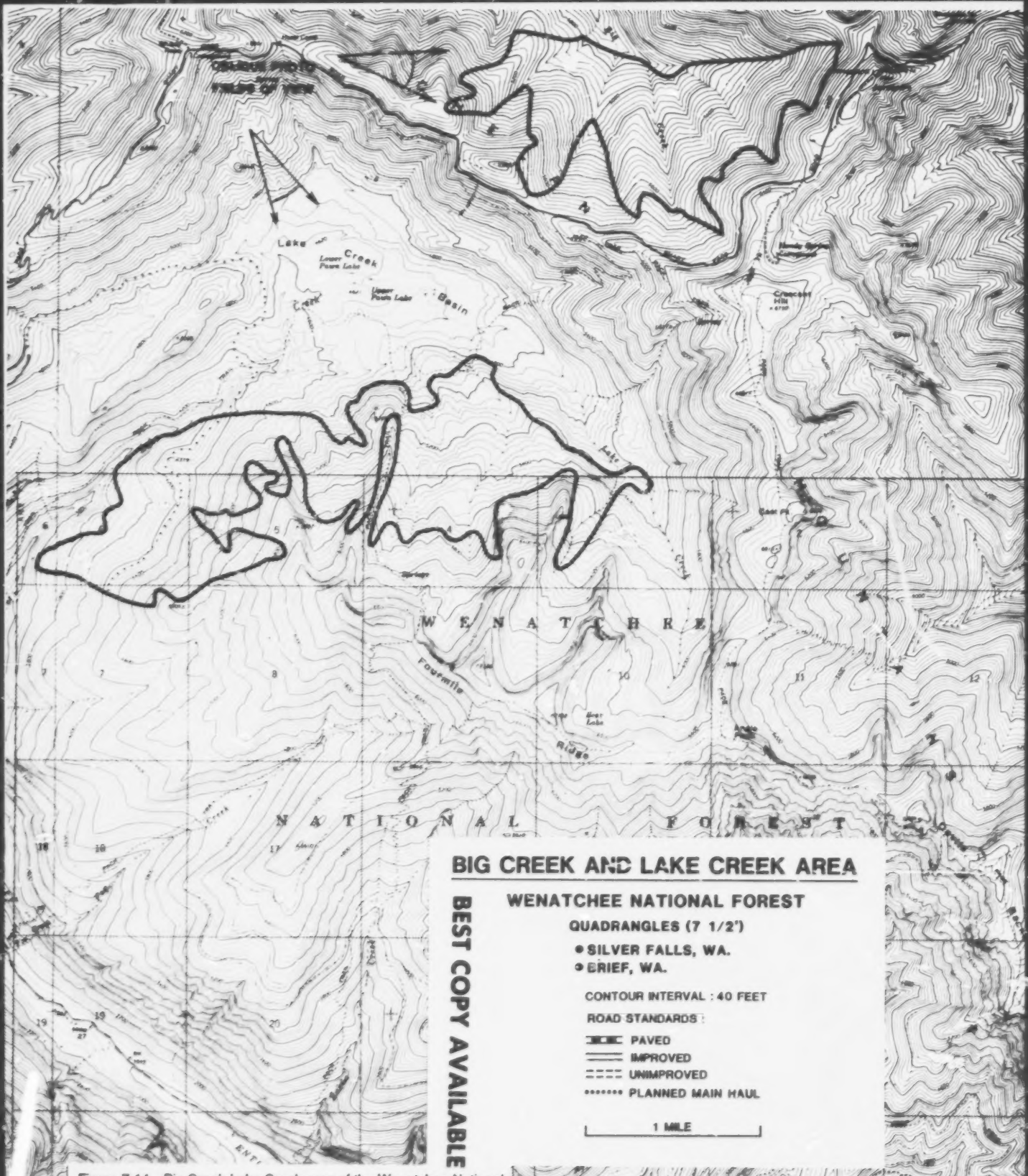

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Figure 7-14—Big Creek-Lake Creek area of the Wenatchee National Forest. The gross area extends from latitude 47°56'59" in the south to 47°59'52" in the north, and from longitude 120°24'13" in the east to 120°30'10" in the west.

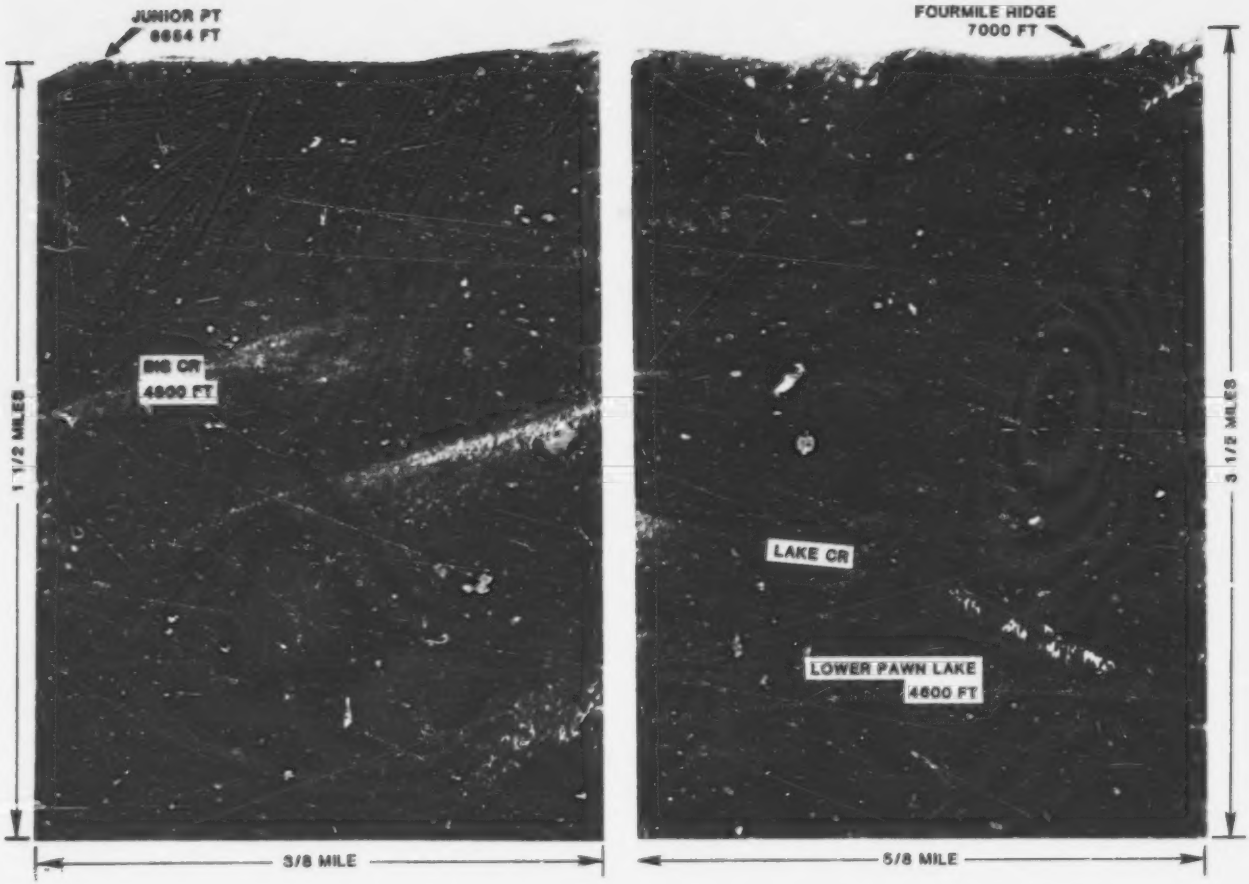

Figure 7-15—Oblique views of Big Creek-Lake Creek area of the Wenatchee National Forest. (Left) Looking east up Big Creek toward Junior Point. Width of foreground shown is about three-eighths mile; from the foreground to the ridgetop road on the skyline is about 1½ miles. (Right) Looking southeast across Lake Creek toward Fourmile Ridge. Width of foreground shown is about five-eighths mile; from the foreground to the ridge on the skyline is about 3½ miles. See figure 7-14 for camera viewpoints and fields.

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Figure 7-16—Looking northeast (at 4,500 feet elevation near west extremity of Lake Creek delineated area) along motorbike trail that runs up the west side of Lake Creek.

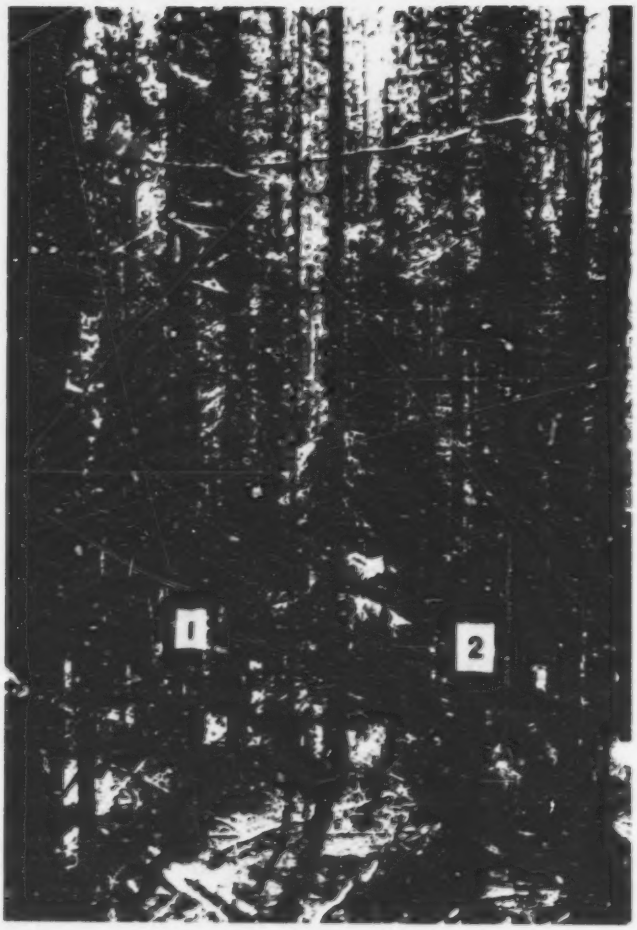

Figure 7-17—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled at an elevation of 4,500 feet just west of Lake Creek and close to the western extremity of the delineated area.

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See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.72	3.97
Tree height above 6-inch high stump, feet	36.0	38.0
Crown ratio, percent	36.1	26.3
Cone serotiny	- no data taken -	
Tree age years (number of annual growth rings)		
Stump height	88	84
20 percent of tree height	63	79
Base of live crown	30	25
Diameter inside bark, inches		
Stump height	4.03	4.28
20 percent of tree height	3.33	3.43
Base of live crown	2.28	1.93
Height from stump top to base of crown, inches	276	336
Stem taper inside bark, inches/100 inches		
Below crown	0.63	0.74
Within crown	1.46	1.50
Rings/inch, average for section		
Stump height	44	39
Base of live crown	26	28
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	117.0	78.5
Specific gravity, ovendry weight and green volume	0.380	0.402
Rings/inch in first 1¼ inches radius	34	20
Maximum crushing strength, lb f/in²	6,050	5,480
Proportional limit, lb f/in²	4,500	3 740
Modulus of elasticity, lb f/in²	1,270,000	1,140,000
Compression wood evident?	none	slight
Spiral grain angle at surface, degrees	2	5
Bark thickness (single), inch	0.14	0.11
Pith eccentricity, inch	0.2	0.4

Inventory Data—Inventory data for the area are incomplete. For comments on typical diameter distribution and tree height, see text under paragraph heading "General Character of the Timber."

Cubic Yield Potential and Height Growth—Although data are not well documented, managers responsible for the area estimate that current stands are growing at the rate of 30 to 40 ft³ of stemwood per acre per year; the potential for managed stands is estimated at 100 ft³ per acre per year. Fifty-year height growth in managed stands is estimated to be about 60 feet.

Management Objectives for the Area and Constraints—The primary objective is phased harvest of the stagnated stands and natural regeneration with vigorous, new, controlled-density lodgepole stands. Such harvests would be timed to enhance wildlife habitat and to protect watershed and recreational values.

The principal obstacle to achievement of management objectives is lack of markets for subsawlog-size stumpage growing on steep slopes with poor access. In the Entiat River drainage, small volumes of more accessible large-pole/small-sawlog lodgepole pine stumpage on tractor ground have been sold for $20 per M bd ft Scribner scale, with the purchaser bearing the cost of temporary road construction and cleanup following harvest.

Other Lodgepole Pine Available in the Area From Public Lands—Approximately 40,000 acres on the Entiat and Chelan Ranger Districts are now growing lodgepole pine, or will be growing it on the extensive areas burned by forest fires since 1970.

Forest Products Industry in the Vicinity—In Entiat, a doweling plant utilizes lodgepole pine with minimum top diameter of 7 inches to produce parts for playground structures. A sawmill cutting ponderosa pine and Douglas-fir is located in Peshastin, and a mill cutting 2- by 4-inch studs operates in Cashmere. In Wenatchee there is a market for large chips used in smelting operations.

Population in the Vicinity—In 1985 the total population of Chelan County was 48,500. Wenatchee, the county seat, has a population of 17,360, Chelan 3,000, and Entiat 492 (1985 data).

In 1981, annual per-capita income in Chelan County was $10,826, and 12.8 percent of those in the workforce were unemployed.

STATE FOREST

Area Name and Location—The delineated Loomis Block area (figs. 7-8, 7-18, and 7-19), which lies at an elevation of 4,400 to 6,193 feet at latitude 48°59' and longitude 119°47', is in the Northwest Management Area of the Washington State Forest; the area is headquartered in Colville.

The gross area of 2,120 acres includes about 1,700 acres of lodgepole pine timber type and falls entirely within Okanogan County. The town of Okanogan is the county seat. It is immediately south of the Canadian border, which forms the area's northern edge (fig. 7-18). The center of the delineated area is 14 air miles northwest of Loomis on a heading of 328°. Long Swamp Campground, on the northern edge of the 89,000-acre Meadows area of the Okanogan National Forest, lies only 11 air miles to the southwest on a heading of 205°.

Maps of the Area—USGS quadrangle 15' maps needed to depict the area are: Horseshoe Basin and Loomis.

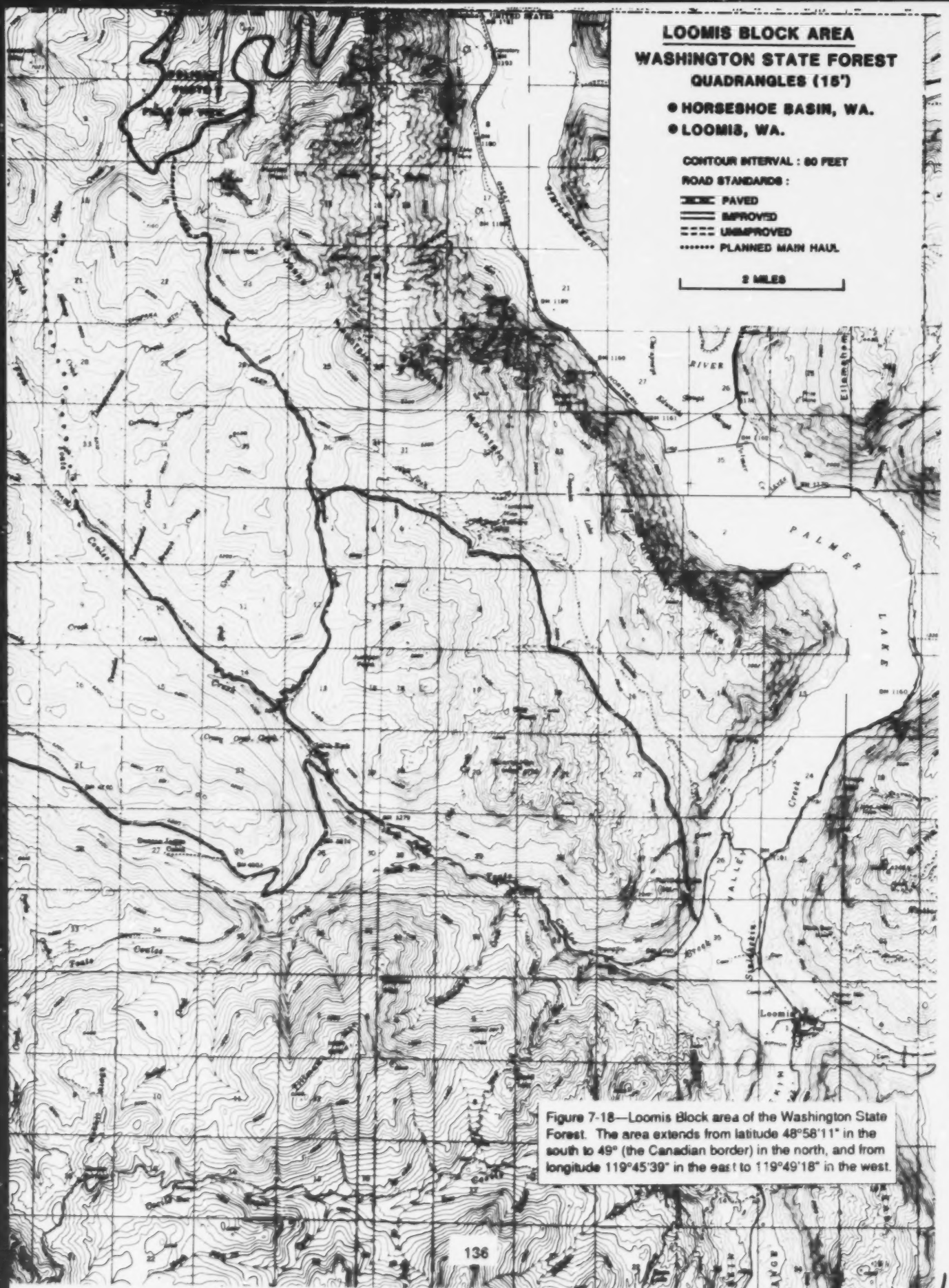

Figure 7-18—Loomis Block area of the Washington State Forest. The area extends from latitude 48°58'11" in the south to 49° (the Canadian border) in the north, and from longitude 119°45'39" in the east to 119°49'18" in the west.

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Figure 7-19—Oblique view of the Loomis Block area of the Washington State Forest looking south from near the Canadian border. See figure 7-18 for camera viewpoint and field. Joe Mills Mountain is just out of view to the left (east) of Disappointment Ridge. The old fire trail in center foreground connects to the unimproved dirt access road shown in figures 7-18 and 7-20.

Access—From Loomis (1,300 feet elevation) a paved road runs 9.8 miles northwest (to near North Fork Camp) from whence an all-weather gravel road extends 6.6 miles north and terminates at 6,250 feet elevation at the Cold Springs Picnic Area. Beyond this, a primitive jeep trail (portions washed out) runs another 6 miles north-northwest over a 7,000-foot ridge to descend to the southern border of the area (fig. 7-20).

A new main haul road is planned that will approach the southwest corner of the area via lower elevations along Toats Creek and Olallie Creek (figs. 7-18 and 7-21).

Tonasket and Omak, on the Burlington Northern line from Oroville to Wenatchee, are nearby railheads. Tonasket is about 18 highway miles southwest of Loomis and 24 miles north of Omak. For highway distances from Omak to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 4,400 and 6,193 feet elevation, mostly with northwest and north aspect, and with nearly two-thirds of the acreage having slopes of less than 45 percent. Soils are stony, coarse and fine sandy loams (fig. 7-20).

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals 20 to 35 inches. In winter, snow commonly accumulates to depths of 3 to 10 feet. The snow-free season generally extends from June 1 through October.

General Character of the Timber—The lodgepole pine trees in the delineated area are typically about 70 years old, 30 to 40 feet high, and 1 to 6 inches in d.b.h.—with an average of about 3 inches. Stems tend to retain dead limbs (fig. 7-22). Undergrowth is light, and down timber not prominent. Most of the stands date from forest fires near the turn of the century.

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Figure 7-20—Looking south along the jeep-trail access road 1¼ miles south of the southern border of the Loomis Block area of the Washington State Forest; elevation is 6,800 feet.

Figure 7-21—Looking southwest across the North Fork of Toats Creek and the vicinity of the planned major haul road (fig. 7-18) extending toward the delineated Loomis Block area of the Washington State Forest.

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Figure 7-22—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled at 6,400 feet elevation along the jeep-trail access road about 2 miles south of the southern border of the delineated Loomis Block area of the Washington State Forest.

Mortality from mountain pine beetles is not evident, nor is damage from porcupines. At upper elevations just below tree line, massed cankers (burls) are present on lower stem sections of a significant number of the lodgepole pines along the jeep-trail access road south of the area.

Because of inaccessibility and low value of the trees, no harvests have been made in the delineated area, and none are planned for the immediate future. Where access is easier in the State forest in the vicinity, however, approximately 1,200 acres of lodgepole pine forest type will be harvested annually over the next 5 years (1987-92).

Data on Sample Trees—A pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. were destructively sampled from gently sloping terrain at 6,400 feet elevation along the jeep-trail access road about 2 miles south of the delineated area (fig. 7-22). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.67	3.31
Tree height above 6-inch high stump, feet	31.0	32.0
Crown ratio, percent	48.9	45.8
Cone serotiny	- no data taken -	
Tree age years (number of annual growth rings)		
Stump height	49	47
20 percent of tree height	37	37
Base of live crown	24	23
Diameter inside bark, inches		
Stump height	3.81	3.52
20 percent of tree height	3.17	2.93
Base of live crown	2.55	2.29
Height from stump top to base of crown, inches	190	208
Stem taper inside bark, inches/100 inches		
Below crown	0.66	0.59
Within crown	1.40	1.30
Rings/inch, average for section		
Stump height	26	27
Base of live crown	19	20
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	129.1	92.5
Specific gravity, ovendry weight and green volume	0.380	0.400
Rings/inch in first 1¼ inches radius	19	25
Maximum crushing strength, lb f/in²	5,130	5,220
Proportional limit, lb f/in²	3,620	3,890
Modulus of elasticity, lb f/in²	950,000	1,080,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	3	0
Bark thickness (single), inch	0.15	0.10
Pith eccentricity, inch	0.1	0.1

Inventory Data—Inventory data on the delineated area are lacking. Data gleaned from timber type maps made in the 1960's are summarized under the paragraph heading "General Character of the Timber."

Cubic Yield Potential and Height Growth—Although data are not well documented, the managers estimate that the area currently has about 1,500 ft³ of stemwood per acre; the growth potential for managed stands is estimated to be double that of existing stands. Fifty-year height growth in managed stands is estimated to be 30 to 40 feet.

Management Objectives for the Area and Constraints—The primary management objective is phased harvest of the stagnated stands and replacement

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through natural regeneration with vigorous, new, controlled-density lodgepole pine stands. No thinning of the new stands is contemplated.

Appropriately timed, such harvests should enhance habitat for the substantial population of mule deer in the vicinity and also protect watershed and recreational values.

As noted previously, the principal obstacle to achieving these management objectives is lack of markets for small-diameter trees distant from haul roads.

Other Lodgepole Pine Available in the Area From Public Lands—Outside the delineated area, but within the general vicinity where access is easier, the State plans to harvest about 6,000 acres in the years 1987-92. Further south and adjacent to the Okanogan National Forest, the State has an additional 30,000 acres of similar lodgepole pine forest type for which there is little market. The State prices lodgepole pine sawtimber stumpage on these acres at $14 to $25 per M bd ft Scribner scale.

As noted in discussion of the Meadows area of the Okanogan National Forest, an additional 48,000 acres of lodgepole pine timber type lies south of Long Swamp, only 11 air miles southwest from the State's delineated area (fig. 7-8).

Forest Products Industry in the Vicinity—A portable sawmill cutting 2- by 4-inch studs is in operation cutting lodgepole pine timber from State lands in the vicinity.

Fixed-location sawmills manufacturing random-length dimension lumber are located in Oroville, Tonasket vicinity, Republic, and Omak vicinity. The mill in Omak also has a plywood plant. Additionally, there is a large plant near Omak that manufactures pine lumber (mostly ponderosa pine) for furniture. South of Oroville on the Burlington Northern rail line there is a facility for transshipping (reloading) pulp chips en route to plants on the Columbia River west of the Cascade Mountains.

The Tonasket mill is a modern small-log operation with annual capacity of about 60 million bd ft of random-length dimension lumber.

Population in the Vicinity—In 1980 the total population of Okanogan County was 30,639, and the town of Okanogan—the county seat—had a population of 2,302. Omak, with a population of 4,007, is the largest community in the county. In 1984, annual per-capita income was $10,949 in Okanogan County, and during 1985, 16.0 percent of those in the workforce were unemployed.

REFERENCES

Bassett, Patricia M.; Oswald, Daniel D. 1981a. Timber resource statistics for southwest Washington. Resour. Bull. PNW-91. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 24 p.

Bassett, Patricia M.; Oswald, Daniel D. 1981b. Timber resource statistics for the Olympic Peninsula, Washington. Resour. Bull. PNW-93. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 31 p.

Bassett, Patricia M.; Oswald, Daniel D. 1982. Timber resource statistics for the Puget Sound area, Washington. Resour. Bull. PNW-96. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 31 p.

Bassett, Patricia M.; Oswald, Daniel D. 1983. Timber resource statistics for eastern Washington. Resour. Bull. PNW-104. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 32 p.

CHAPTER 8: WYOMING

INTRODUCTION

In Wyoming, lodgepole pine predominates on about 1.8 million acres of the State's 4.3 million acres of commercial forest land, with about 3.0 billion ft³ of lodgepole pine growing stock and 10.7 billion bd ft of sawtimber (table 8-1). Approximately 40 percent of the softwood growing stock and 36 percent of the softwood sawtimber in the State is lodgepole pine (Green and Van Hooser 1983).

Approximately 45 percent of the dry weight of aboveground biomass in lodgepole pine trees in Wyoming is in trees smaller than the 10-inch d.b.h. class (table 8-2).

Managers of public forest lands in Wyoming selected for study four areas (fig. 8-1) totaling 143,880 acres in gross area. The study areas are individually described in the following text.

Table 8-1—Volume of lodgepole pine growing stock and sawtimber, and acreage in lodgepole pine, by ownership class, Wyoming[1]

Ownership class	Growing stock[2]	Sawtimber volume[3]	Commercial timberland area
	Million ft³	*Million bd ft International ¼-inch scale*	*Thousand acres*
National Forest (commercial)[4]	2,558	9,677	1,569
Other public	190	455	110
Forest industry	—	—	—
Other private	224	617	122
Total	2,972	10,749	[5]1,801

[1]Source: Green and Conner [In preparation]. Information presented is based on 1985 data.

[2]**Growing stock volume** = net volume in cubic feet of live sawtimber and pole timber trees (5 inches d.b.h. and larger) from stump to a minimum 4-inch top outside bark, or to the point where the central stem breaks into limbs.

[3]**Sawtimber volume** = net volume in board feet of the sawlog portion of live sawtimber trees. Sawtimber trees are live trees of commercial species, 9 inches in d.b.h. or larger (softwood), containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect.

[4]**Commercial timberland** = forest land that is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. Areas qualifying as commercial timberland have the capability of producing in excess of 20 ft³ per acre per year of industrial wood in natural stands.

Table 8-2—Dry weight of lodgepole pine trees, by tree component and diameter class—Wyoming[1]

Diameter class	Bole[2]	Top[2]	Total
Inches	*- - Thousand tons, ovendry basis - -*		
2	—	2,296	2,296
4	—	5,297	5,297
6	5,368	3,870	9,238
8	7,024	2,275	9,299
10	8,110	2,187	10,297
12	6,537	1,900	8,437
14	4,781	1,268	6,049
16	2,339	606	2,945
18	1,570	396	1,966
20+	1,353	358	1,711
Total	37,082	20,453	57,535

[1]Source: Van Hooser and Chojnacky (1983).

[2]**Trees 5+ inches d.b.h.:** Bole weight = ovendry weight of wood and bark from a 1-foot stump to a 4-inch top diameter, inside bark; top weight = ovendry weight of wood and bark from a 4-inch diameter to tip of tree, plus branch material down to ¼-inch diameter.

Trees less than 5 inches d.b.h.: Total ovendry weight of wood and bark from a 1-foot stump to tip of tree, plus branch material down to ¼-inch diameter (tabulated under "Top").

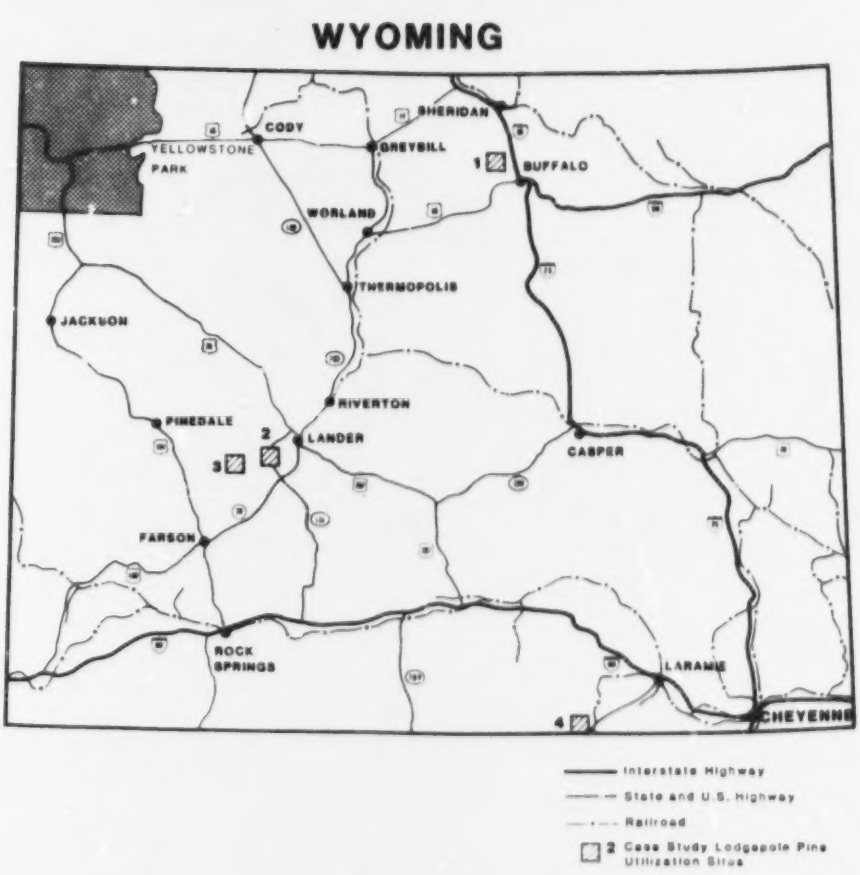

Figure 8-1—Wyoming location map. 1. Bighorn NF (Piney Creek-Rock Creek) 75,000 acres. 2. Shoshone NF (Grannier Meadow-Dickinson Park area) 35,000 acres. 3. Bridger-Teton NF (South Wind River area) 41,000 acres. 4. Medicine Bow NF (Upper Pelton Creek area) 7,880 acres.

BIGHORN NATIONAL FOREST

Area Name and Location—The Piney Creek-Rock Creek area (figs. 8-2, 8-3, and 8-4), which lies at an elevation of 6,500 to 9,800 feet at latitude 44°27' and longitude 107°, is in the Buffalo and Tongue Ranger Districts of the Bighorn National Forest; the Ranger Stations are in Buffalo and Sheridan, respectively.

The gross area of about 75,000 acres includes about 50,000 acres of lodgepole pine timber type and lies entirely within Johnson County; Buffalo is the county seat. The area is centered around Willow Park Reservoir just east of the Cloud Peak Wilderness area. The center of the north border of the area is 15 air miles due south of Sheridan. The center of the south border of the area is 13 air miles due west of Buffalo.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Big Horn, Cloud Peak, Hunter Mesa, Lake Angeline, Little Goose Peak, Park Reservoir, Stone Mountain, Storey, and Willow Park.

Access—Access to the area is difficult. The principal route penetrating the area is via a gated dirt road, privately built to maintain an irrigation system originating at the Willow Park Reservoir, and negotiable by four-wheel-drive vehicles. The lower terminus (at about 4,800 feet elevation) of this dirt road is 19 miles south of Sheridan just south of Storey at Little Piney Creek (fig. 8-3). From this lower terminus the road climbs steeply for 4 or 5 miles (with sharp switchbacks) through private land before reaching the National Forest boundary at 7,500 feet—the lower edge of the lodgepole pine forest type. From the lower terminus of the dirt road it is 12 miles to Willow Park Reservoir, which lies at an elevation of 8,600 feet.

The only other access road is the Red Grade road west of Sheridan; this dirt road ascends an 18-percent grade to the plateau at the north border of the area. In spite of its steepness, logs are now hauled down this road—usually at night to avoid recreational traffic—to the Sheridan area, a distance of about 40 miles from the area's north border.

To avoid this grade, a main haul road is planned that would enter the area from the northwest and traverse Penrose Park to reach Willow Park Reservoir. Log trucks using this route could descend U.S. Highway No. 14 to the railhead town of Ranchester—a haul distance of about 65

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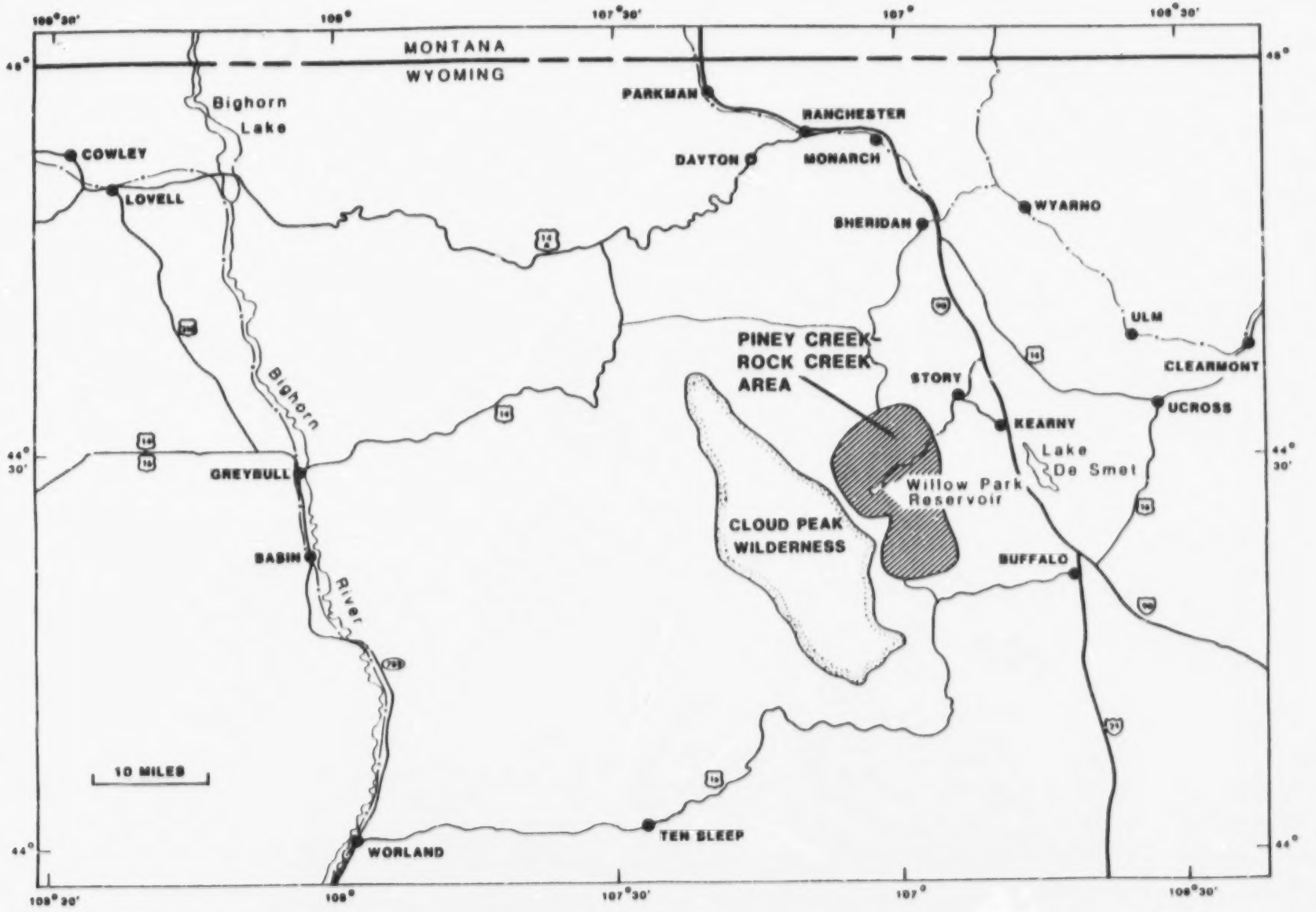

Figure 8-2—Vicinity map for the Piney Creek-Rock Creek area of the Bighorn National Forest in Wyoming.

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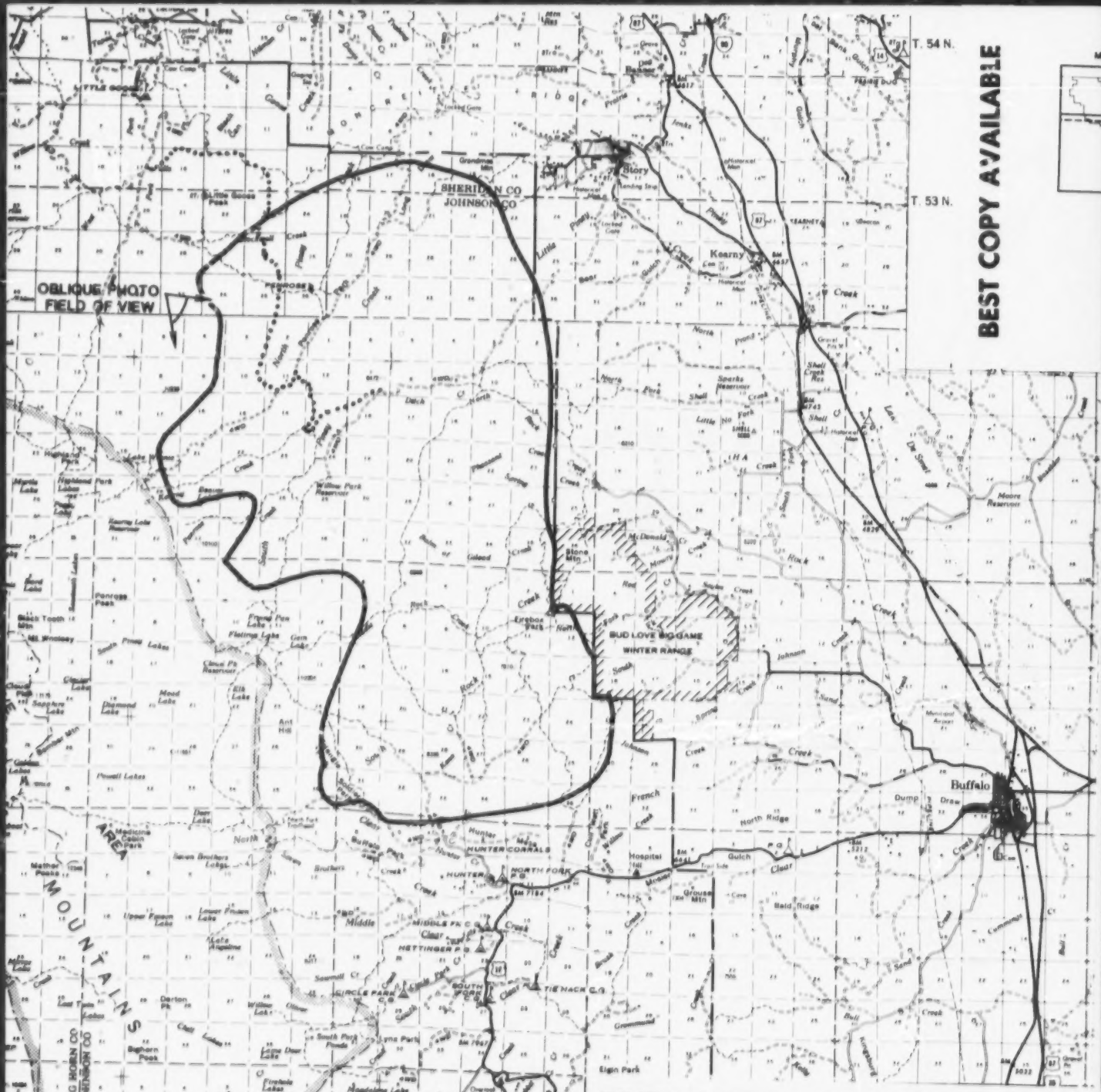

Figure 8-3—Piney Creek-Rock Creek area of the Bighorn National Forest. The area extends from latitude 44°20'11" in the south to 44°34'01" in the north, and from longitude 106°53'16" in the east to 107°07'14" in the west. See text for list of USGS quadrangle maps depicting the area. The Cloud Peak Wilderness, as recently defined, is larger than the Cloud Peak Primitive Area delineated on this map.

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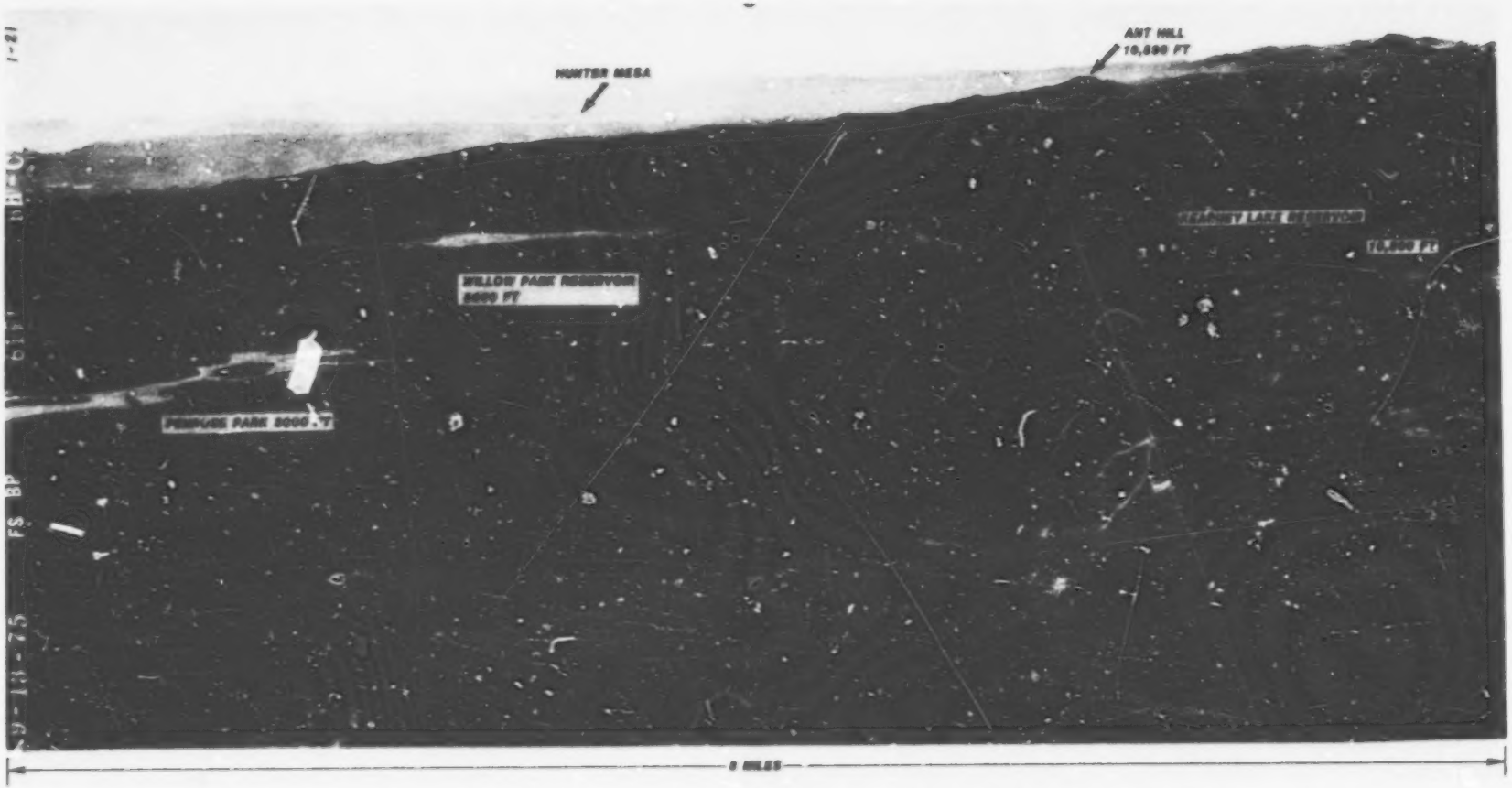

Figure 8-4.—Oblique view of Piney Creek-Rock Creek area of the Bighorn National Forest looking southeast across Penrose Park and Willow Park Reservoir toward Ant Hill Peak; see figure 8-3 for approximate camera viewpoint and field. Width of foreground shown is about 8 miles. From the line of peaks traversing the center foreground of the photo to the dark timbered ridge in the background is 8 to 10 miles. The immediate foreground is in the Cloud Peak Wilderness area.

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miles. Surveyed, but not presently scheduled for construction, is a haul road from U.S. Highway No. 16 in the south to Willow Park Reservoir.

U.S. Highways No. 16 and No. 14 are kept open all year, but U.S. Alternate No. 14 is closed by snow between mid-November and the end of May.

Railhead towns in the vicinity include Sheridan, and Ranchester 13 miles to the northwest; both are on the Burlington Northern line from Billings, MT, to Edgemont, SD.

For highway distances from Sheridan to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 6,500 and 9,800 feet elevation. Of the approximately 50,000 acres of lodgepole pine timber type, about nine-tenths have slopes less than 45 percent. The terrain has occasional rock outcroppings, and sizable stones are scattered on the forest floor. Undergrowth is light. Soils are fast draining, of granitic origin, and lack the volcanic ash layer frequently found in lodgepole areas to the north and west. Except for distance from roads and the occasional rock outcroppings, there are no special obstacles to harvesting (fig. 8-5).

Annual Precipitation and Duration of Snow-free Season—Annual precipitation is about 15 inches along the eastern border of the area, 20 to 25 inches in most of the area, and up to 30 inches along the western border—most falling as snow.

General Character of the Timber—Almost all of the timber is less than 9 inches in d.b.h., with diameters of 4 to 7 inches predominating. Stocking varies from moderate (fig. 8-6) to dense (fig. 8-7). The stands originated from forest fires during the period from 1870 to 1900. Undergrowth is moderate and down timber not excessive.

Mortality from mountain pine beetle is not evident, but western gall rust and comandra rust are common. There has been no harvesting in the area, not even by producers of crossties. Plans for future harvests are dependent on gaining road access.

Data on Sample Trees—A pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. were destructively sampled from near-level terrain at an elevation of 8,400 feet about 1½ miles northeast of Willow Park Reservoir (fig. 8-7). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.80	3.60
Tree height above 6-inch high stump, feet	28.8	28.2
Crown ratio, percent	36.2	43.2
Cone serotiny	open	open
Tree age years (number of annual growth rings)		
Stump height	103	108
20 percent of tree height	85	82

Figure 8-5.—View from 1 mile north of Willow Park Reservoir in the Bighorn National Forest looking northwest across Ditch Creek into the gentle terrain surrounding Penrose Park, which is visible in the center distant background.

Characteristic	Tree number 1	Tree number 2
Base of live crown	50	64
Diameter inside bark, inches		
Stump height	3.77	3.85
20 percent of tree height	3.35	3.30
Base of live crown	2.30	2.57
Height from stump top to base of crown, inches	220	192
Stem taper inside bark, inches/100 inches		
Below crown	0.67	0.67
Within crown	1.84	1.76
Rings/inch, average for section		
Stump height	55	56
Base of live crown	43	36
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	86.5	86.6
Specific gravity, ovendry weight and green volume	0.419	0.408
Rings/inch in first 1¼ inches radius	40	42
Maximum crushing strength, lb f/in²	5,130	5,350
Proportional limit, lb f/in²	3,060	3,690
Modulus of elasticity, lb f/in²	1,110,000	1,190,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	0	1
Bark thickness (single), inch	0.15	0.11
Pith eccentricity, inch	0.1	0.1

Inventory Data—Timber in the area has been type mapped, but inventory data are incomplete. Managers responsible for the area estimate stand data typical of the area as follows:

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Figure 8-6—Open stand of lodgepole pine on plateau about 6 miles northeast of Willow Park Reservoir along irrigation access road up Little Piney Creek in the Bighorn National Forest.

D.b.h. class *Inches*	Live stems per acre (including culls) *Number*	Average height *Feet*	Age *Years*
<2.9	412	10	30
3.0-3.9	208	25	70
4.0-4.9	155	32	75
5.0-5.9	123	36	80
6.0-6.9	106	38	80
7.0-7.9	77	40	85
8.0-8.9	25	44	90
9.0+	23	50	100+
Total	1,129		

Cubic Yield Potential and Height Growth—Managers responsible for the area estimate that in managed stands 80 years old, with stocking of 500 to 600 trees per acre, trees should measure 50 to 55 feet high and 7 or 8 inches in d.b.h.; this translates into an annual growth rate of about 42 ft³ of stemwood per acre per year. Fifty-year height growth in managed stands is estimated at 40 feet. Current volume growth is about 19 ft³ per acre per year.

Management Objectives for the Area and Constraints—The area is primarily managed as spring, summer, and fall elk habitat—although it is also heavily utilized as summer pasture for cattle. Utilization for timber is secondary to wildlife considerations. Within this constraint, managers have the objective of creating some stand diversity by phased harvests and stand replacement with vigorous, new, controlled-density stands of lodgepole pine. Appropriately timed, such harvests could enhance elk habitat and preserve watershed, range, and recreational values.

When sales of similar timber are made in the vicinity of the area, dead trees for firewood bring $5 per cord stumpage, and small lodgepole sawtimber stumpage brings $10 or $12 per M bd ft Scribner scale.

Figure 8-7—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled at an elevation of 8,400 feet about 1½ miles northeast of Willow Park Reservoir in the Bighorn National Forest.

Other Lodgepole Pine Available in the Area From Public Lands—On the Bighorn National Forest north of the delineated area there are about 75,000 acres of lodgepole pine timber similar to that within the area. South along U.S. Highway No. 16 there are another 20,000 acres of similar timber. Because the lodgepole pines on these acres are almost all of subsawtimber size, existing mills have little use for them

Forest Products Industry in the Vicinity—There is only one major sawmill in the area; it is located in Sheridan and manufactures 2- by 4-inch studs, mostly from lodgepole pine. Additionally, there is a small sawmill in Buffalo and a post-and-pole operation in Sheridan. West of the area, another post-and-pole operation is located in Manderson, between Greybull and Worland.

Population in the Vicinity—Johnson County has a total population of 6,850; population of Buffalo, the county seat, is 3,850. Sheridan has a population of 15,146 and Ranchester has 655—all based on 1980 data.

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In 1983, per-capita income in Johnson County was $11,496, and in 1986 approximately 8.0 percent of those in the workforce were unemployed.

BRIDGER-TETON NATIONAL FOREST

Area Name and Location—The South Wind River area (figs. 8-8, 8-9, and 8-10), which lies at an elevation of 8,000 to 9,500 feet at latitude 40°37' and longitude 109°13', is in the Pinedale Ranger District of the Bridger-Teton National Forest; the Ranger Station is in Pinedale.

The gross area of 41,000 acres includes more than 10,000 acres of lodgepole pine forest type. Most of the area lies within Sublette County, but the extreme southeastern portion is in Fremont County; Pinedale and Lander, respectively, are the county seats. The area lies just south of the Bridger Wilderness, and the crest of the Wind River Range lies to the northeast (fig. 8-9). The northwest corner of the area is 16 air miles due east of Boulder. Big Sandy Lodge and Campground, near the center of the area, is 75 air miles due north of Rock Springs.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Pocket Creek Lake, Big Sandy Opening, Leckie, Jensen Meadows, Sweetheart Needles, and Christina Lake.

Access—Forest Service Road No. 116 running north from Dutch Joe Guard Station to Big Sandy Lodge and Campground is the only improved road in the area, although a few unimproved dirt roads approach the perimeter and penetrate some parts (fig. 8-9).

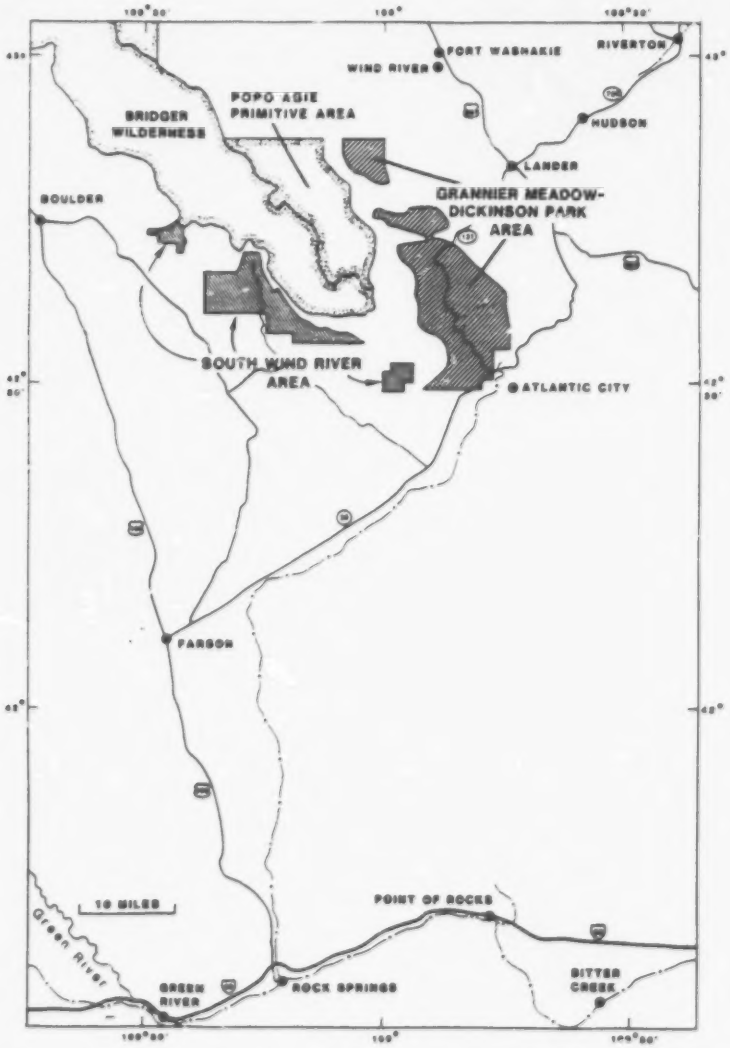

Figure 8-8—Vicinity map for the South Wind River (Bridger-Teton National Forest) and Grannier Meadow-Dickinson Park (Shoshone National Forest) areas of Wyoming. The rail line shown from Rock Springs to Atlantic City is a private line.

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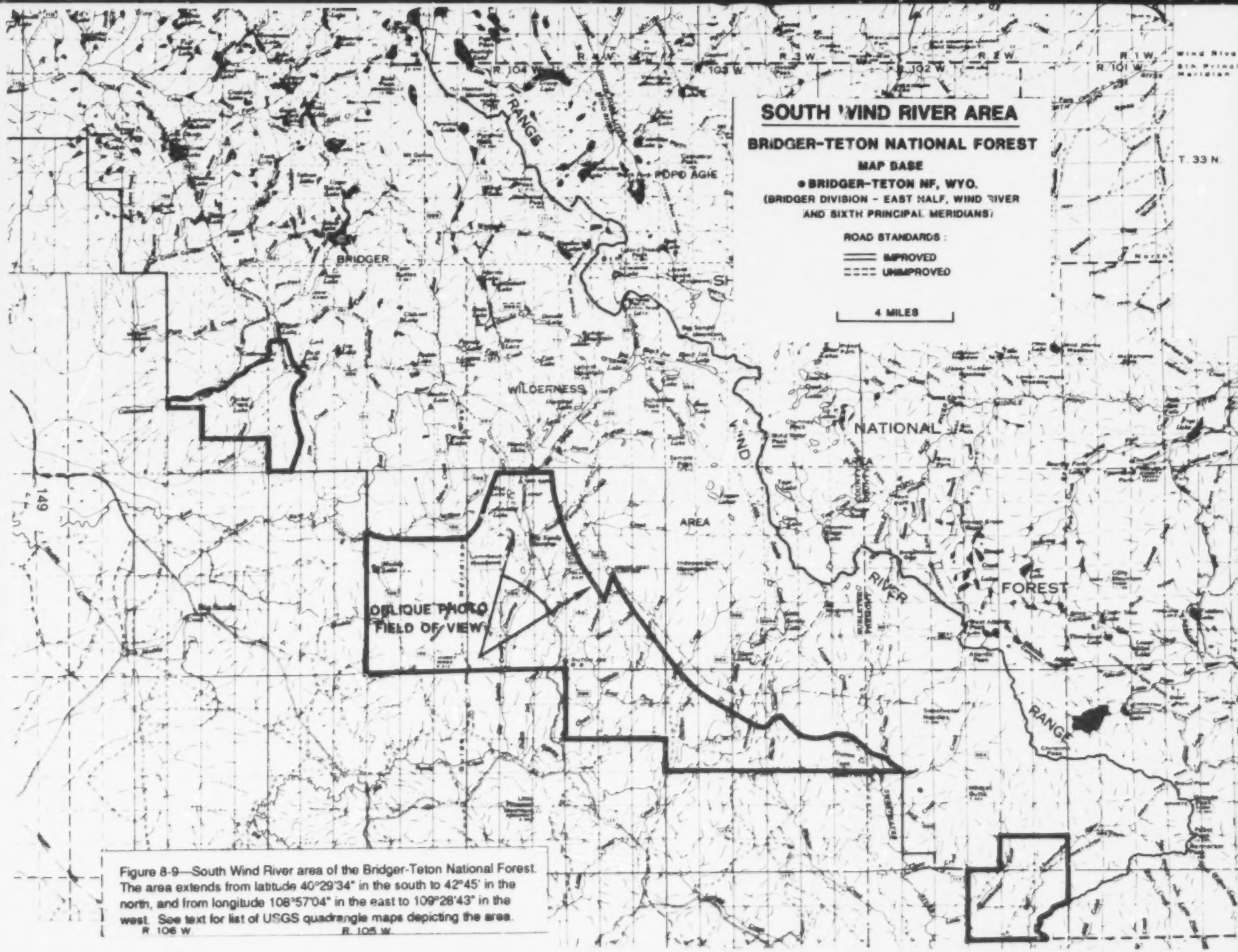

Figure 8-9—South Wind River area of the Bridger-Teton National Forest. The area extends from latitude 40°29'34" in the south to 42°45' in the north, and from longitude 108°57'04" in the east to 109°28'43" in the west. See text for list of USGS quadrangle maps depicting the area.

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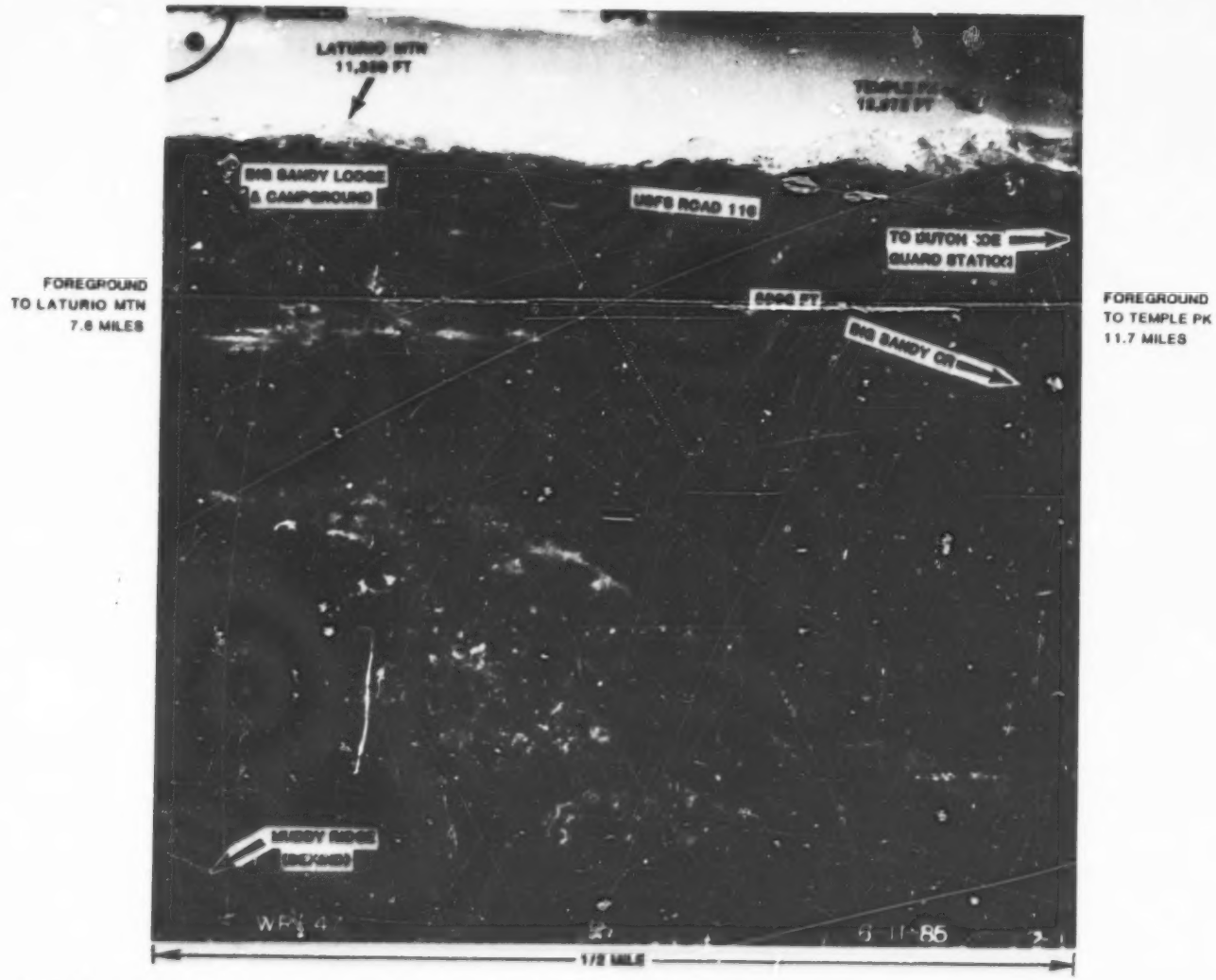

Figure 8-10—Oblique view of the South Wind River area of the Bridger-Teton National Forest looking northeast from near Muddy Ridge toward Big Sandy Opening. See figure 8-9 for camera viewpoint and field. Width of foreground is about one-half mile. From foreground to Laturio Mountain on the left skyline is 7.6 miles and from foreground to Temple Peak is 11.7 miles.

Pinedale (elevation 7,200 feet), 12 miles northwest of Boulder and 100 highway miles north of Rock Springs, is the nearest community of some size; it is 56 road miles from Big Sandy Lodge and Campground. The nearest railhead is on the Union Pacific line at Rock Springs, 98 road miles from Big Sandy Lodge and Campground via Farson (the rail line to Atlantic City, WY, is a private line). For highway distances from Rock Springs to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the timbered area lies mostly between 8,000 and 9,500 feet, with about three-fourths of the lodgepole pine timber type on slopes of less than 45 percent (fig. 8-10). Soils are shallow granitics containing cobble rocks. Other than remoteness from roads, there are no special obstacles to harvesting. Variable-size bodies of timber are interspersed with meadows.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation totals about 30 inches, most of which falls as snow. Snow accumulation in winter may total 10 feet. The snow-free season generally extends from early June through mid-November.

General Character of the Timber—Trees are mostly 70 to 150 years old, with many stands dating from the last major fire in the area which occurred more than 100 years ago. Typically, stands are deteriorated and not extremely dense (fig. 8-11), although some stagnated, densely stocked sapling/pole stands are present (fig. 8-12). In older stands most stems are larger than 4 inches in d.b.h., and a few are as large as 28 inches. Dead limbs tend to be retained, and crown ratios are relatively large. Stringers of aspen typically run from meadow edges into many of the lodgepole stands (fig. 8-13).

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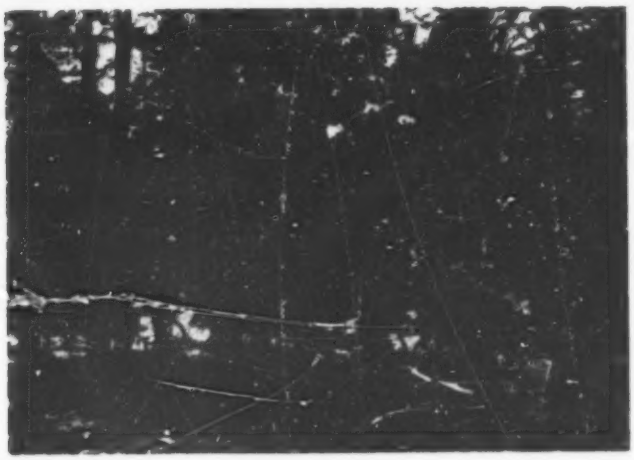

Figure 8-11—Moderately open stand of lodgepole pine of various diameters (up to 28 inches in d.b.h.) about 2 miles south of Big Sandy Campground adjacent to Forest Service Road No. 116 in the South Wind River area of the Bridger-Teton National Forest.

Figure 8-13—Stringers of small aspen among lodgepole pine stands in the vicinity of Dutch Joe Guard Station in the South Wind River area of the Bridger-Teton National Forest.

Figure 8-12—Sapling/pole stand of lodgepole pine near Dutch Joe Guard Station in the South Wind River area of the Bridger-Teton National Forest.

Attacks by mountain pine beetles over the years account for some of the size diversity within the more open stands (fig. 8-11). The most recent epidemic-size infestation began in 1965 on adjacent Bureau of Land Management lands and has since progressed up various drainages in the area. Dwarf mistletoe is present in many stands.

More than 20 years ago there were some small clearcuts (less than 100 acres) made in the Muddy Ridge vicinity, and some older partial cuts along the road from Dutch Joe Guard Station to Big Sandy Lodge and Campground. With these exceptions, there has been no harvesting in the area.

Data on Sample Trees—A pair of adjacent codominant lodgepole pines 3½ to 4 inches in d.b.h. were destructively sampled at 8,950 feet from nearly level terrain a couple of miles south of Big Sandy Lodge and Campground. Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.80	3.75
Tree height above 6-inch high stump, feet	38.5	37.3
Crown ratio, percent	81.8	77.9
Cone serotiny	open	closed
Tree age years (number of annual growth rings)		
Stump height	92	92
20 percent of tree height	65	61
Base of live crown	67	61
Diameter inside bark, inches		
Stump height	3.85	3.90

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Characteristic	Tree number 1	Tree number 2
20 percent of tree height	3.37	3.38
Base of live crown	3.45	3.33
Height from stump top to base of crown, inches	84	99
Stem taper inside bark, inches/100 inches		
Below crown	0.48	0.58
Within crown	0.91	0.96
Rings/inch, average for section		
Stump height	48	47
Base of live crown	39	37
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	106.2	128.6
Specific gravity, ovendry weight and green volume	0.378	0.366
Rings/inch in first 1¼ inches radius	37	31
Maximum crushing strength, lb f/in²	4,940	4,510
Proportional limit, lb f/in²	2,890	2,720
Modulus of elasticity, lb f/in²	880,000	780,000
Compression wood evident?	none	slight
Spiral grain angle at surface, degrees	0	0
Bark thickness (single), inch	0.12	0.08
Pith eccentricity, inch	0.1	0.3

Inventory Data—Inventory data on the area are incomplete. At considerable risk of oversimplification, managers responsible for the area estimate that of the more than 10,000 acres of lodgepole pine forest type, about 80 percent are in seedling/pole stands and the remainder in stands of larger trees—most of the latter typified by figure 8-11. Typical stand data for these two types are estimated by the managers to be about as follows:

D.b.h. class	Seedling/pole stands	Larger-tree stands
Inches	*Number of live stems per acre*	
<2.9	100	—
3.0-3.9	150	—
4.0-4.9	150	—
5.0-5.9	200	—
6.0-6.9	200	—
7.0-7.9	150	—
8.0-8.9	50	15
9.0+	—	210
Total	1,000	225

Cubic Yield Potential and Height Growth—Although data are not well documented, managers responsible for the area estimate that in managed stands growth rate in the area should be about 85 ft³ of stemwood per acre per year. Fifty-year height growth in managed stands is estimated to be about 45 feet.

Management Objectives for the Area and Constraints—The area is primarily managed as elk habitat; also, portions of it are much used for recreation. Utilization for timber in some portions of the area is therefore secondary. Within these constraints, managers have the objective of creating some stand diversity by phased harvests and stand replacement with naturally regenerated, vigorous, controlled-density stands of lodgepole pine. Appropriately timed, such harvests could enhance elk habitat and preserve watershed, range, and recreational values.

The major obstacle to accomplishment of this objective is lack of markets for subsawlog-size stumpage.

Other Lodgepole Pine Available in the Area From Public Lands—If product values were sufficient to justify long log hauls, a plant at Rock Springs might draw on lodgepole pine acreages on the Ashley National Forest in Utah and, possibly, that portion of the Shoshone National Forest just east of the South Wind River area.

Forest Products Industry in the Vicinity—Aside from some small post-and-pole operations, there are no major wood processing facilities in the vicinity of the South Wind River area.

Population in the Vicinity—The population of Sublette County is 4,600; Pinedale, the largest community and the county seat, has a population of 1,067 (based on 1980 data). In 1984, per-capita income in Sublette County was $12,077; in 1985, 4.9 percent of those in the workforce were unemployed. These latter two statistics were favorably influenced by a large construction project in the county during 1984 and 1985.

Rock Springs, with a population (1986) of 20,812, is the largest community in Sweetwater County (population 44,739). In 1985, 7.4 percent of those in the workforce in Sweetwater County were unemployed. Per-capita income in the county was $12,227 in 1984.

MEDICINE BOW NATIONAL FOREST

Area Name and Location—The Upper Pelton Creek area (figs. 2-17, 8-14, and 8-15), which lies at an elevation of 8,400 to 9,400 feet at latitude 41°03′ and longitude 106°12′, is in the Laramie Ranger District of the Medicine Bow National Forest; the Ranger Station is in Laramie.

The gross area of 7,880 acres includes about 7,100 acres of lodgepole pine timber type and falls entirely within Albany County; Laramie is the county seat. The area is centered around Illinois Creek and the Pelton Creek north drainage. It lies immediately north of, and adjoins, the Colorado border where Wyoming State Highway No. 230 crosses into Colorado. From Laramie, the center of the area is 40 air miles southwest on a heading of 240°. The midpoint of the north border is 4 air miles due west of Foxpark.

Maps of the Area—USGS quadrangle 7½′ maps needed to depict the area are: Foxpark, WY; Kings Canyon, CO-WY; Northgate, CO-WY; and Horatio Rock, WY-CO.

Access—All-weather paved Wyoming State Highway No. 230 leads 44 miles southwest from Laramie to the southern border of the area, from whence improved Forest Service Road No. 898 forms the southwest border of the area. Improved roads provide access to the southeast portion of the area, traverse the middle of the area from west to east, and

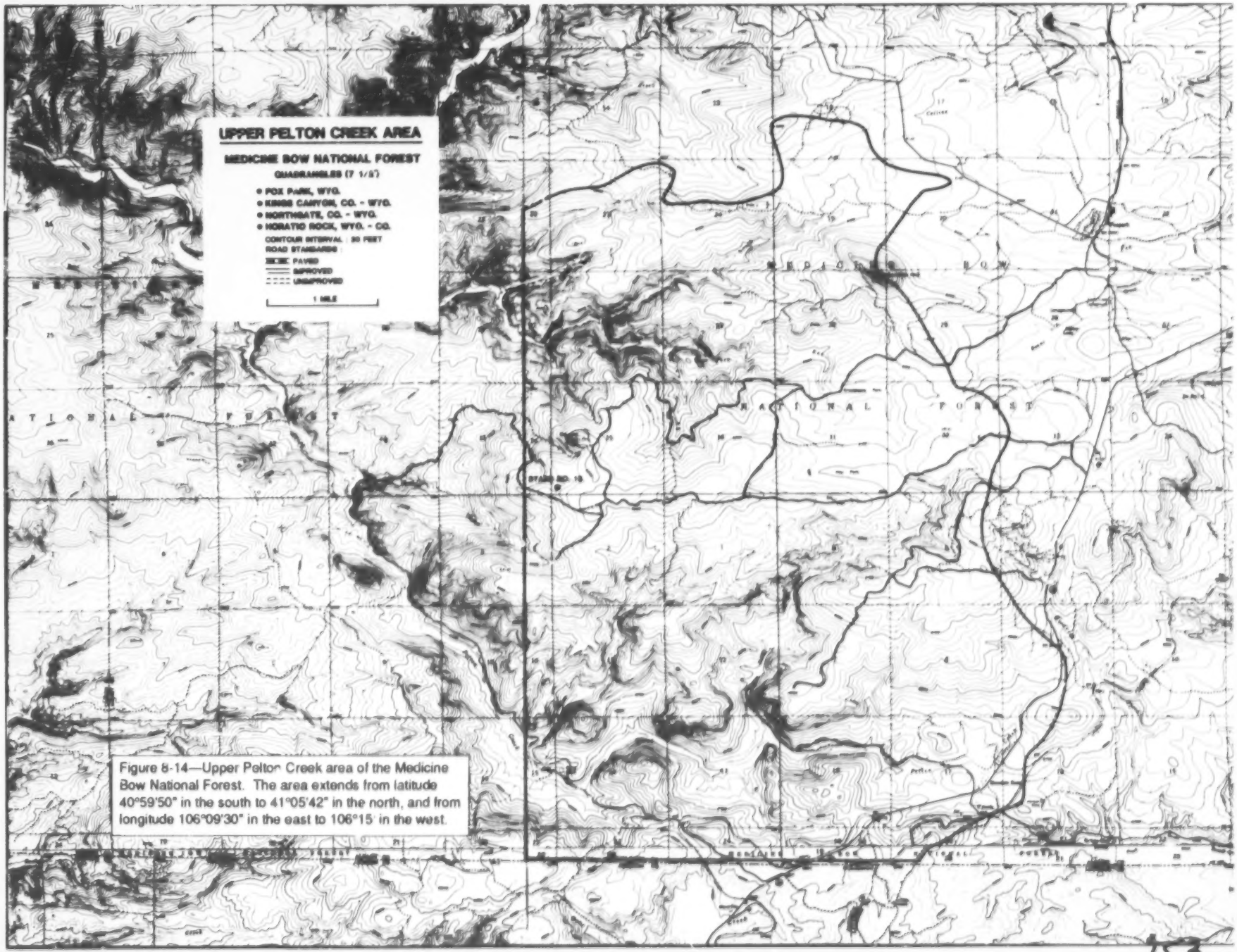

Figure 8-14—Upper Pelton Creek area of the Medicine Bow National Forest. The area extends from latitude 40°59'50" in the south to 41°05'42" in the north, and from longitude 106°09'30" in the east to 106°15' in the west.

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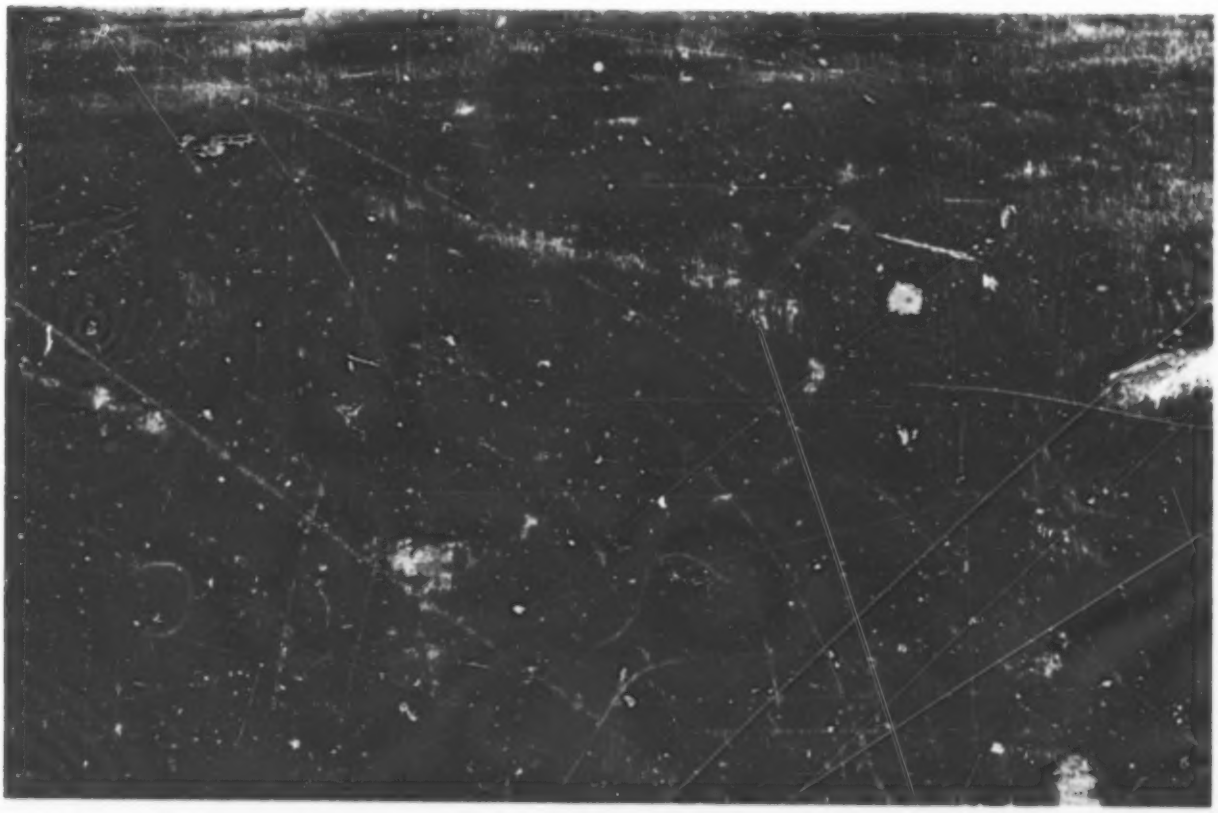

Figure 8-15—Oblique view of typical terrain and vegetation on the 9,000-foot plateau comprising the Upper Pelton Creek area of the Medicine Bow National Forest.

connect with State Highways No. 230 to the east and No. 130 to the north (fig. 8-14). From just south of Douglas Point it is 6 road miles to Foxpark and 30 road miles to State Highway No. 130 just east of Centennial; from this junction to Laramie is an additional 26 miles.

A Union Pacific branch line from Walden, CO, to Centennial, WY, passes through Foxpark and along the east border of the area. Laramie is the nearest sizable railhead community and is on a main line of the Union Pacific. For highway distances from Laramie to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies between 8,400 and 9,400 feet elevation, with more than four-fifths of the acreage having slopes of less than 45 percent; average slope for the area is about 15 percent. In many parts of the area there is little forest-floor vegetation (figs. 8-16 and 8-17) soils; elsewhere, grass and grouse whortleberry are plentiful. There is no volcanic ash layer forming topsoil. Except that timber from steep slopes must be logged uphill to minimize sedimentation in streams below, and to avoid need for roads in riparian areas, there are no special obstacles to harvesting.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation in the area totals 25 to 30 inches, mostly from thunderstorms or falling as snow. To the east at Foxpark, weather data indicate an average of only 17.1 inches of annual rainfall. The snow-free season in the area generally extends from mid-June to mid-October.

General Character of the Timber—Most of the lodgepole pines are 3 to 8 inches in d.b.h. and 35 to 50 feet in height (figs. 8-16, 8-17, and 8-18). Dead limb retention is not excessive, and crown ratios are generally less than 40 percent. Most stands are 60 to 100 years of age, dating from extensive harvesting during the late 1800's and early 1900's for railroad crossties—and also from forest fires during these years.

Forked stems and those with crook probably number less than 10 percent of the live stems. Cankers and damage from porcupines occur on only a small proportion of stems. Currently, mortality from mountain pine beetle is light. Dwarf mistletoe, however, infests a high proportion of all lodgepole pine trees. Cones in many stands are predominantly closed (serotinous), while those in other stands are open.

Because the trees are predominantly of subsawlog-size, no large harvests are planned in the immediate future; some small sales to post-and-pole operators are planned.

Data on Sample Trees—A pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. were destructively sampled from level terrain at 9,100 feet elevation just south of

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Figure 8-16—Lodgepole pines—mostly 3 to 8 inches in d.b.h.—with little ground vegetation at 8,700 feet along the North Fork of Pelton Creek in the Medicine Bow National Forest.

Figure 8-17—Light component of dead wood on ground typical of lodgepole pine stands in the southeast portion of the Upper Pelton Creek area of the Medicine Bow National Forest. Largest trees measured 9 inches in d.b.h. and were about 90 years old; most were 3 to 8 inches in d.b.h.

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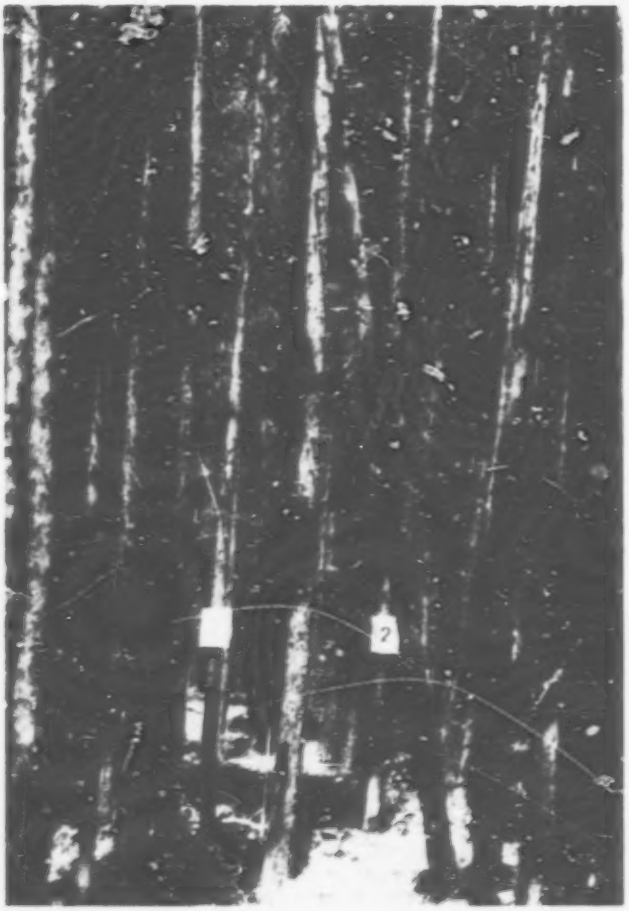

Figure 8-18—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled at 9,100 feet elevation from Stand #16 just south of Douglas Point in the Upper Pelton Creek area of the Medicine Bow National Forest.

Douglas Point (fig. 8-18). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.87	3.87
Tree height above 6-inch high stump, feet	38.2	39.0
Crown ratio, percent	36.6	28.6
Cone serotiny	closed	closed
Tree age years (number of annual growth rings)		
Stump height	100	103
20 percent of tree height	90	84
Base of live crown	59	41
Diameter inside bark, inches		
Stump height	3.80	2.90
20 percent of tree height	3.53	3.29
Base of live crown	2.44	1.93
Height from stump top to base of crown, inches	289	334
Stem taper inside bark, inches/100 inches		
Below crown	0.47	0.53
Within crown	1.44	1.44
Rings/inch, average for section		
Stump height	51	53
Base of live crown	48	42
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	89.7	88.4
Specific gravity, ovendry weight and green volume	0.430	0.418
Rings/inch in first 1¼ inches radius	32	32
Maximum crushing strength, lb f/in²	5,500	6,230
Proportional limit, lb f/in²	4,120	5,520
Modulus of elasticity, lb f/in²	1,160,000	1,420,000
Compression wood evident?	none	none
Spiral grain angle at surface, degrees	0	4
Bark thickness (single), inch	0.13	0.13
Pith eccentricity, inch	0.3	0.4

Inventory Data—Inventory data on the area are incomplete, with completion planned by 1990. As noted previously, most of the lodgepole pine in the area is of subsawlog size. Live lodgepole pine stems in one unthinned 46-acre stand south of Douglas Point (Stand #16) were estimated to have a diameter distribution as follows:

D.b.h. class *Inches*	Number of stems per acre
<3.0	0
3.0-4.9	100
5.0-6.9	260
7.0-8.9	288
9.0-10.9	12
11.0+	0
Total	660

It seems likely that this stand had a smaller than typical component of stems smaller than 3 inches in d.b.h.

Cubic Yield Potential and Height Growth—Although data are not well documented, area managers estimate that current lodgepole pine stands are currently growing at a rate of about 30 ft³ of stemwood per acre per year; the potential is estimated at 50 ft³ per acre per year. Fifty-year height growth in managed stands is estimated to be 30 to 40 feet.

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Management Objectives for the Area and Constraints—The primary objective is phased harvest of the stagnated stands and natural regeneration with vigorous, new, controlled-density lodgepole stands. Appropriately timed, such harvests should enhance elk and deer habitat and protect watershed and recreational values.

The principal obstacle to achievement of objectives is the lack of markets for the typically small lodgepole pine trees. Small-sawlog stumpage currently sells for about $6 per M bd ft Scribner scale, although higher prices have been obtained in the past. Posts and poles bring about $100 per acre, and firewood stumpage sells for $5 per cord. Lodgepole pines for Christmas trees sell for $3 each, on the stump.

Other Lodgepole Pine Available in the Area From Public Lands—In addition to the 7,100 acres of lodgepole pine timber type in the Upper Pelton Creek area, the Medicine Bow National Forest has approximately 25,000 additional acres of similar lodgepole pine within a 75-mile haul radius of Foxpark. Also, the Routt National Forest in Colorado has significant acreages of lodgepole pine, but the extent was not investigated.

Forest Products Industry in the Vicinity—In the immediate vicinity, there is a medium-size sawmill in Foxpark. More distant are larger mills in Laramie, Walden, Encampment, and Saratoga. All of these sawmills manufacture random-length dimension lumber.

Also in Laramie is a post-and-pole operation. There is a structural flakeboard plant 140 miles south in Kremmling, CO.

Population in the Vicinity—In 1984 Albany County had a population of 29,833. Laramie, the largest town in the county, and the county seat, has a population of 25,723 (based on 1984 data). The University of Wyoming, with approximately 10,000 students, is located in Laramie.

Per-capita income in Albany County was $11,013 in 1984, and 4.6 percent of those in the workforce were unemployed in 1985.

SHOSHONE NATIONAL FOREST

Area Name and Location—The Grannier Meadow-Dickinson Park area (figs. 8-8, 8-19, and 8-20), which lies at an elevation of 8,400 to 11,000 feet at latitude 42°41' and longitude 108°53', is in the Lander Ranger District of the Shoshone National Forest; the Ranger Station is in Lander.

The gross area of approximately 35,000 acres includes about 20,000 acres of lodgepole pine forest type and falls entirely within Fremont County; Lander is the county seat. The area is centered along a northwest to southeast axis that runs from Dickinson Park in the northwest past Worthen Meadow Reservoir and Louis Lake to Grannier Meadow in the southeast (fig. 8-19). From Lander, it is 16 air miles due west to Dickinson Park in the center of the northwest portion of the area. Atlantic City is 5 air miles due east of the center of the south border of the area.

Maps of the Area—USGS quadrangle 7½' maps needed to depict the area are: Louis Lake, Christina Lake, Fossil Hill, Cony Mountain, Mount Arter, and Mount Arter SE.

Access—Access to the northernmost border in the vicinity of Dickinson Park is via an all-weather road (which may be closed to logging traffic) leading south through the Wind River Indian Reservation (fig. 8-19); from the north border, a dirt road leads south to Dickinson Park. Acreage to the east of Petes Lake northwest of Sinks Canyon can be reached on a dirt road, which may be closed because it runs through private land.

The major acreage lies south of Sinks Canyon. A paved road runs 8 miles southwest from Lander (elevation 5,400 feet) to the Sinks Canyon Campground (7,000 feet), from whence an all-weather road (State No. 131) climbs south for another 11 miles to about 8,600 feet at the junction with a dirt road leading a couple of miles west to Worthen Meadow Reservoir. From this junction it is 15 miles south via No. 131 past Louis Lake to State Highway No. 28 at the southernmost border of the area (at an elevation of 8,400 feet and near Atlantic City).

The nearest active railhead is at Riverton, 23 highway miles northeast of Lander, on a branch line connected to the Burlington Northern rail line at Shoshone. There is a private rail line from Rock Springs to Atlantic City (fig. 8-8), but it is inactive.

For highway distances from Riverton to various market centers in the United States, see table 1-2.

Terrain and Soil—As previously noted, the area lies mostly between 8,400 and 11,000 feet elevation, with about three-fifths of the area having slopes of less than 45 percent. In most areas the forest floor is littered with boulders and large stones (fig. 8-21), and rocky outcroppings and slopes are prevalent.

Annual Precipitation and Duration of Snow-free Season—Annual precipitation averages about 20 inches. The snow-free season usually extends from late June to the second week in October.

General Character of the Timber—The lodgepole pine stands are typically 80 to 150 years old. Most trees are shorter than 45 feet. Typically there are 100 to 400 live trees per acre smaller than 3 inches in d.b.h. Trees larger than 3 inches in d.b.h. number from about 250 to 650; of these, more than half are less than 7 inches in d.b.h., and only 35 to 85 are larger than 9 inches in d.b.h. (table 8-3; fig. 8-21). In many stands, trees tend to retain dead branches. Also, small aspen trees and other species are intermingled with lodgepole in many stands.

Overall, the lodgepole timber is of lower quality than that found on most of the areas studied. Examination of stumps suggested, however, that even though current tree quality is not high, managed stands might afford satisfactory diameter growth (fig. 8-22).

Mountain pine beetle attacks began about 1970 near the south border of the area and have progressed north to Sinks Canyon. Mortality from beetle attacks has been heavy (as much as 75 percent) at elevations below 9,200 feet. Because of recent and earlier mortality, there are multiple-aged stands as well as the more typical even-aged lodgepole stands.

There has been little harvest activity in the past. Currently, small acreages are harvested annually for firewood (mostly from beetle-killed trees) and for local-use posts and poles.

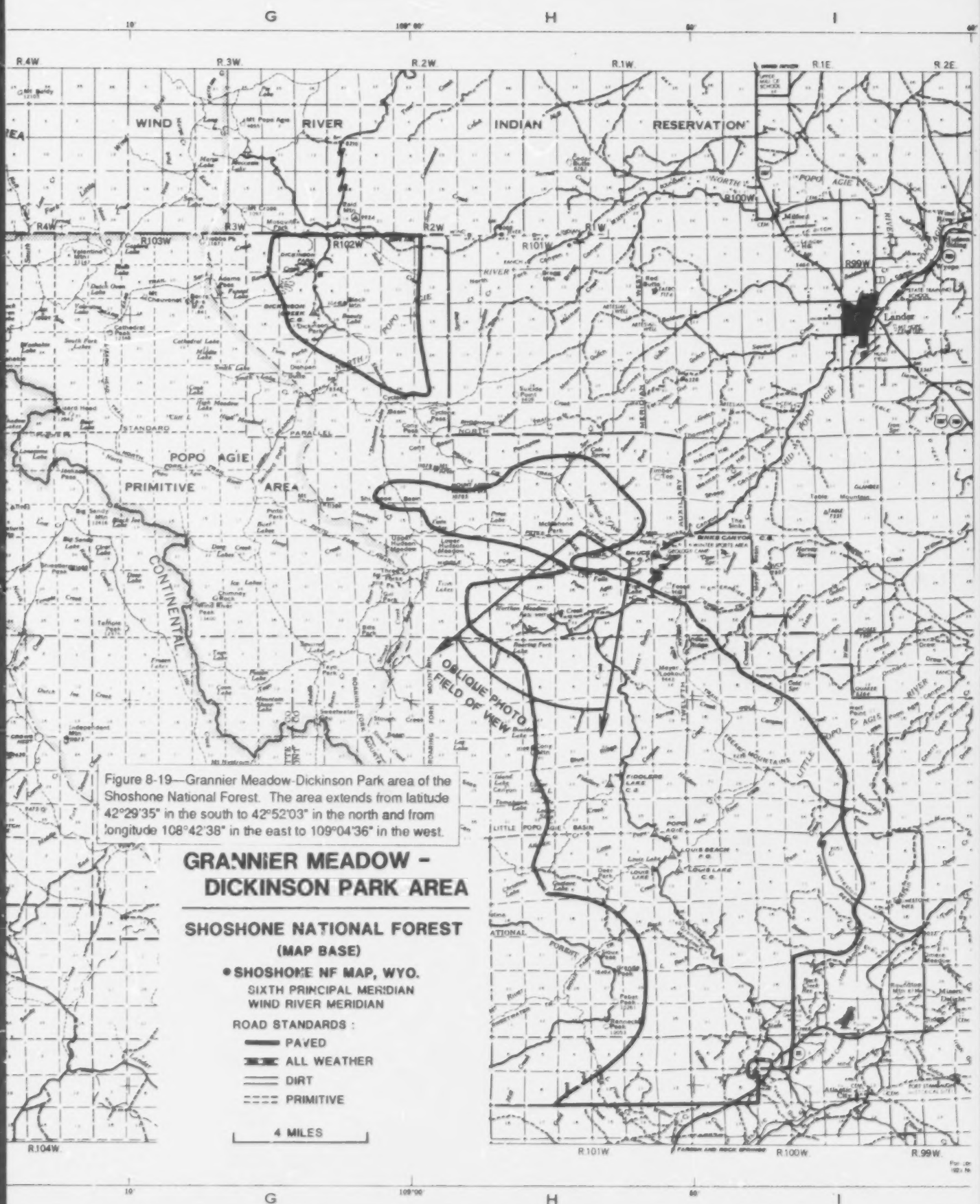

Figure 8-19—Grannier Meadow-Dickinson Park area of the Shoshone National Forest. The area extends from latitude 42°29'35" in the south to 42°52'03" in the north and from longitude 108°42'38" in the east to 109°04'36" in the west.

GRANNIER MEADOW - DICKINSON PARK AREA

SHOSHONE NATIONAL FOREST

(MAP BASE)

• SHOSHONE NF MAP, WYO.
SIXTH PRINCIPAL MERIDIAN
WIND RIVER MERIDIAN

ROAD STANDARDS :
- PAVED
- ALL WEATHER
- DIRT
- PRIMITIVE

4 MILES

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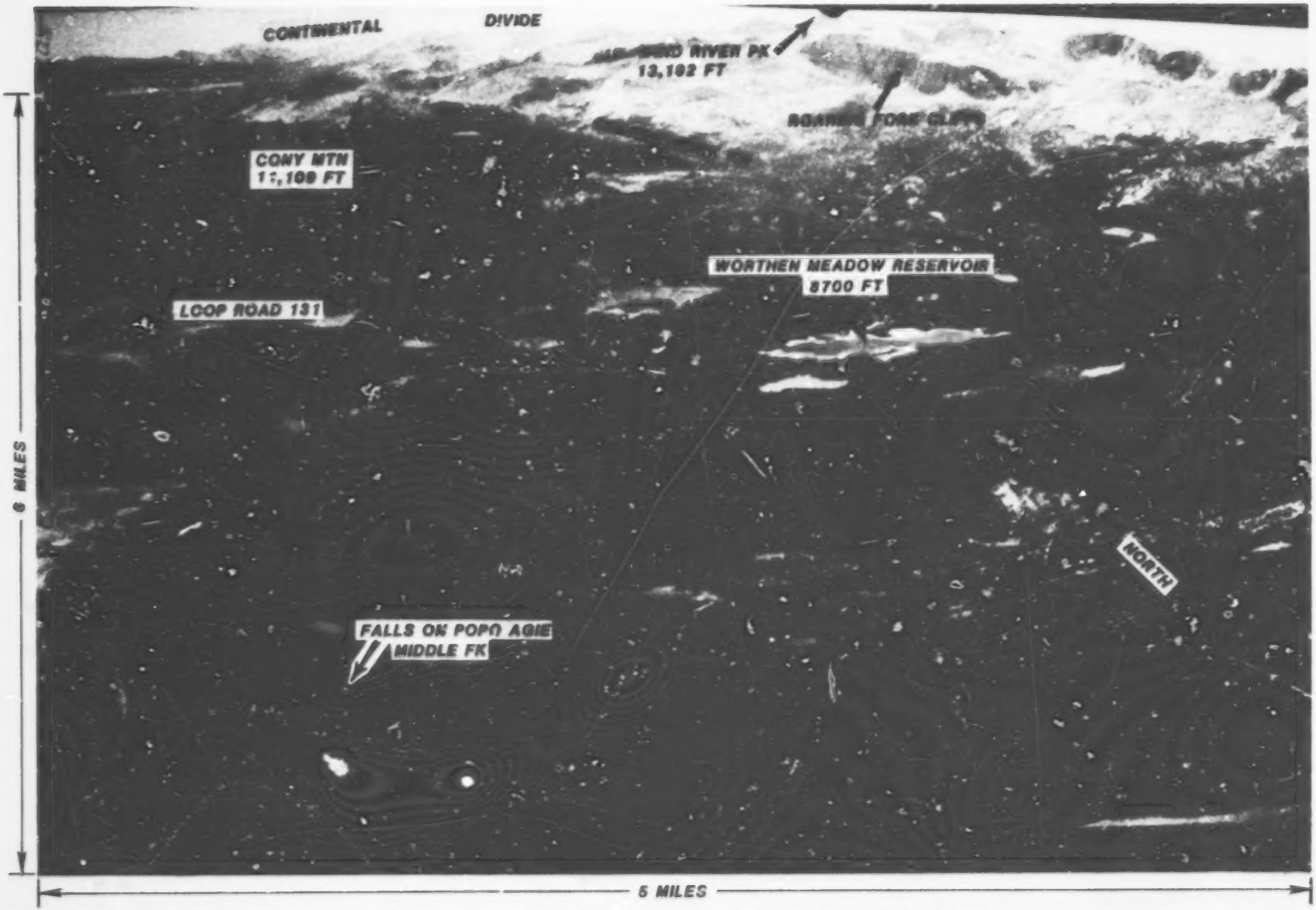

Figure 8-20—Oblique view of the Grannier Meadow-Dickinson Park area of the Shoshone National Forest looking southwest past the falls on the Popo Agie Middle Fork, and over Frye Lake and Worthen Meadow Reservoir toward Cony Mountain and Roaring Fork Creek. See figure 8-19 for camera field of view. Width of foreground is about 5 miles; from foreground to Cony Mountain in the left background is about 6 miles.

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Figure 8-21—Lodgepole pines on typical stony ground immediately south of Worthen Meadow Reservoir in the Grannier Meadow-Dickinson Park area of the Shoshone National Forest.

Table 8-3—Diameter distribution of live trees (mostly, but not all, lodgepole pine) in five typical lodgepole pine type stands of various acreages, stand ages, and classifications on the Lander Ranger District of the Shoshone National Forest

D.b.h. class	#4223 1,126A 80 yr Pole	#4224 4,875A 100 yr Pole	#4225 9,751A 150 yr Overmature	#4226 1,999A 20+ yr Two-aged	#4327 1,139A Overmature diseased
Inches	*Number of trees per acre*				
<3.0	367	129	107	225	250
3.0-3.9	198	90	25	27	101
4.0-4.9	127	91	35	23	59
5.0-5.9	149	121	50	27	59
6.0-6.9	79	88	55	27	51
7.0-7.9	42	67	46	38	44
8.0-8.9	17	42	40	24	36
9.0+	36	42	85	76	60
Total	1,015	670	443	467	660

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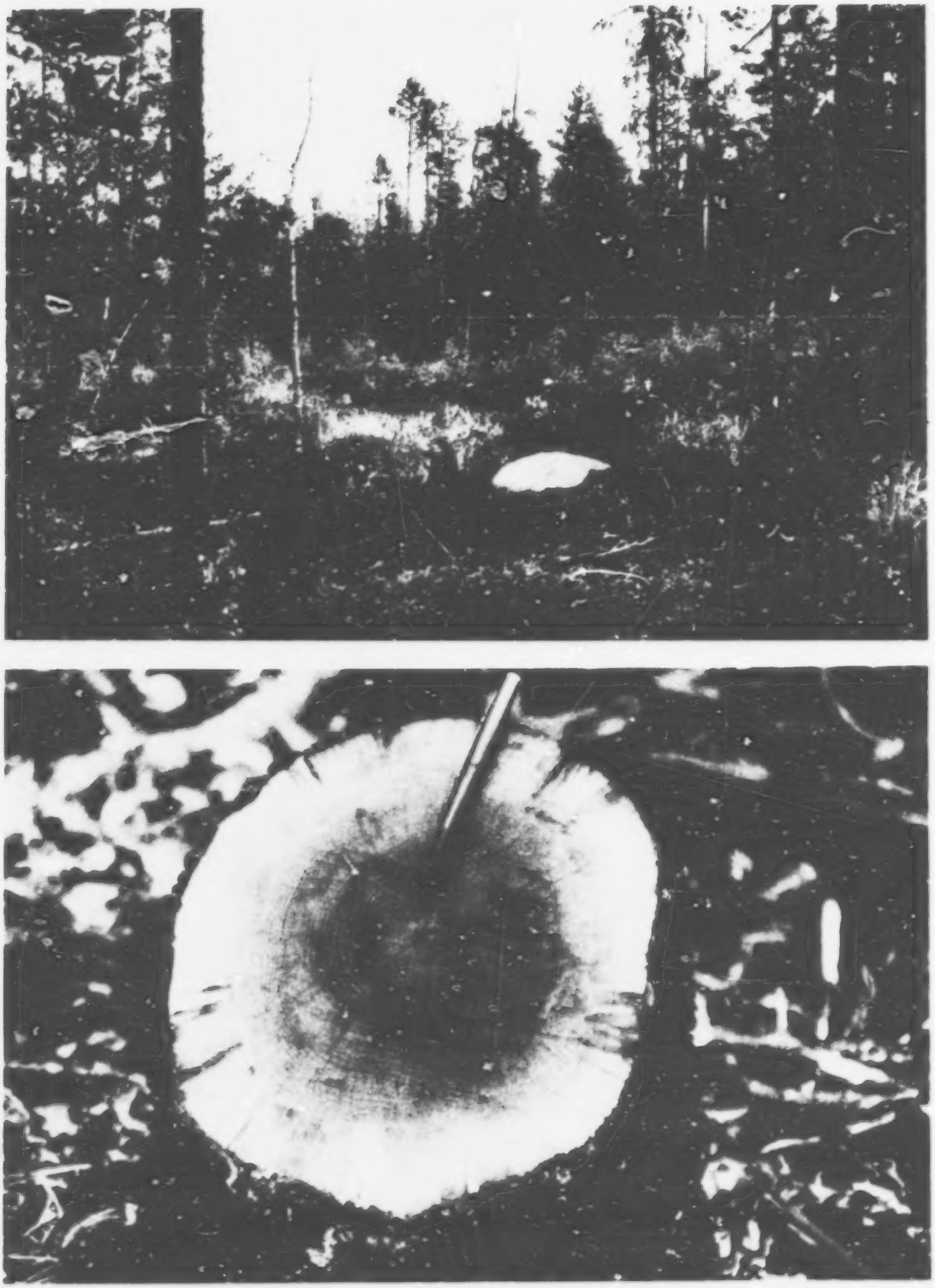

Figure 8-22—At elevation 8,600 feet just east of Frye Lake in the Grannier Meadow-Dickinson Park area of the Shoshone National Forest. (Top) Opening made by firewood cutters removing beetle-killed lodgepole pines. (Bottom) Stump of one of these beetle-killed trees showing uniform fast growth. The pen is 5.3 inches long, and there are 30 annual growth rings showing on the stump.

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Data on Sample Trees—A pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. were destructively sampled at 8,600 feet elevation just east of Frye Lake (fig. 8-23). Some pertinent tree characteristics follow. These tabulated data should not be interpreted as statistically representative of all trees.

See appendix for an explanation of tree selection and procedures for evaluation of mechanical properties in compression parallel to the grain at 10 percent moisture content.

Characteristic	Tree number 1	Tree number 2
D.b.h. (outside bark), inches	3.70	3.58
Tree height above 6-inch high stump, feet	29.5	33.0
Crown ratio, percent	46.9	37.6
Crown serotiny	closed	closed
Tree age years (number of annual growth rings)		
Stump height	92	87
20 percent of tree height	78	72
Base of live crown	54	49
Diameter inside bark, inches		
Stump height	3.66	4.22
20 percent of tree height	3.21	3.13
Base of live crown	2.51	2.13
Height from stump top to base of crown, inches	188	247
Stem taper inside bark, inches/100 inches		
Below crown	0.61	0.85
Within crown	1.51	1.43
Rings/inch, average for section		
Stump height	50	41
Base of live crown	43	46
Properties of stemwood at 20 percent height		
Moisture content, percent ovendry weight	85.8	62.2
Specific gravity, ovendry weight and green volume	0.430	0.435
Rings/inch in first 1¼ inches radius	42	28
Maximum crushing strength, lb f/in²	5,000	6,770
Proportional limit, lb f/in²	3,190	4,170
Modulus of elasticity, lb f/in²	1,160,000	1,430,000
Compression wood evident?	none	slight
Spiral grain angle at surface, degrees	1	4
Bark thickness (single), inch	0.12	0.10
Pith eccentricity, inch	0	0.2

Inventory Data—Inventory data on the area are incomplete. Some stand data for lodgepole pine timber type acreages on the Lander Ranger District are presented in table 8-3 as representative of the lodgepole pine within the delineated area.

Cubic Yield Potential and Height Growth—The lodgepole pine acreage within the delineated area is classified as producing 20 ft³ of stemwood per acre per year. Although data are not well documented, managers responsible for the area estimate the potential growth in managed lodgepole stands at 30 ft³ per acre per year. Fifty-year height growth in managed stands is estimated to be 35 to 40 feet.

Figure 8-23—Pair of codominant lodgepole pines 3½ to 4 inches in d.b.h. sampled at 8,600 feet elevation just east of Frye Lake in the Grannier Meadow-Dickinson Park area of the Shoshone National Forest.

Management Objectives for the Area and Constraints—The area is heavily used for recreation. Currently the area receives minimum-intensity silvicultural treatment. The Forest Plan projects an annual timber harvest from the area of about 1 million bd ft—half from live timber and half from dead. If suitable markets were available for the lodgepole stumpage, phased replacement of overmature, stagnated, or diseased stands would be desirable. The objective would be natural regeneration of vigorous, controlled-density stands of lodgepole. Appropriately timed, such stand replacements would—in addition to aiding local economies—enhance wildlife habitat and preserve watershed, range, and recreational values.

The principal obstacle to attainment of management objectives is lack of markets for the small-diameter, low-quality trees typical of the area—partially attributable to the difficult rocky terrain and lack of convenient access.

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Other Lodgepole Pine Available in the Area From Public Lands—On the entire Shoshone National Forest there are about 144,000 acres of lodgepole pine timber type; only about 86,000 acres sustain a growth rate rapid enough to be classified as suitable for commercial forest. As noted under discussion of the South Wind River area, significant acreages of lodgepole pine timber type are found on the southern end of the Bridger-Teton National Forest across the Continental Divide west of the Grannier Meadow-Dickinson Park area.

Also, the Ashley National Forest, south of Rock Springs, has large acreages of lodgepole pine for which there is little demand.

Forest Products Industry in the Vicinity—There are no major wood-using industries in the immediate vicinity. Cabin log manufacturers are located in Lander and Casper.

Population in the Vicinity—In 1986 Fremont County had a population of about 24,000; Lander, the largest community in the county and the county seat, had a population of 8,254 in 1982. Riverton, the nearest railhead town, had a population of about 9,000 in 1986.

In 1984, annual per-capita income was $10,142 in Fremont County, and 10.4 percent of those in the workforce were unemployed.

REFERENCES

Green, Alan W.; Conner, Roger C. [In preparation]. Wyoming's forests. Resour. Bull. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station.

Green, Alan W.; Van Hooser, Dwane D. 1983. Forest resources of the Rocky Mountain States. Resour. Bull. INT-33. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 127 p.

Van Hooser, Dwane D.; Chojnacky, David C. 1983. Whole tree volume estimates for the Rocky Mountain States. Resour. Bull. INT-29. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 69 p.

CHAPTER 9: SUMMARY

The 28 acreages visited differ greatly. For example, although most are solidly forested in lodgepole pine, some contain significant components of larch, Douglas-fir, subalpine fir, spruce, or aspen. Meadows and grassy openings are common in the lodgepole pine acreages of Colorado and southern Idaho and Wyoming. Growth potential varies from only slightly more than 20 ft^3 per acre per year to more than 100 ft^3 per acre per year. Annual precipitation varies from a low of slightly less than 20 inches to a maximum of near 60 inches. Terrain varies from nearly level to mostly steep; in aggregate, perhaps two-thirds of the lodgepole pine acreage delineated is on slopes of less than 45 percent. A few of the acreages are stony and boulder strewn, but most are not excessively rocky. Mortality—primarily from mountain pine beetle attacks—varies from the preponderance of stems to virtually none of the stems. Defects in live trees that adversely affect utilization in solid wood products include porcupine scars (in some areas occurring on three-quarters of the stems and at several heights in each stem), stem crook, stem sweep, stem fork, cankers, fire scars, frost cracks, pith eccentricity and excessive compression wood content, excessive spiral grain, excessive taper, and excessive limbiness. Degree of defect varies greatly among and within acreages.

Accessibility of the acreages also varies significantly. Almost all have roads to their perimeters, and most have some interior roads; but a few can be reached only on foot. Most are within 50 miles of a railhead, but a few are more distant.

In virtually all of the acreages, stand type varies in a continuum. Classes of stands include: "dog-hair" stands of trees less than 3 inches in d.b.h., pole stands with all trees live, pole stands with many dead trees, pole stands with dense understories of smaller trees, stands of sparsely stocked small sawtimber (usually older than 200 years), vigorous stands of large pole timber (that is, 6 or 7 inches in d.b.h.), stands of dead trees killed by bark beetles (many of suitable size for cabin logs), and stands of a variety of ages and generally low stocking containing relicts of past insect attacks as well as a range of smaller trees—usually suffering from dwarf mistletoe attack and cankers of various descriptions.

The preponderance of lodgepole cubic volume on the acreages visited is found in trees 3 to perhaps 6½ inches in d.b.h.—trees too small to yield sawlogs. Stands are typically 70 to 100 years old, with a few stands younger than 40 years and some older than 200 years.

In the d.b.h. class from 3½ to 4 inches, trees are generally about 35 feet tall, with few shorter than 22 feet and few taller than 55 feet; stemwood-average specific gravity of such trees ranges from 0.36 to 0.52, but is generally 0.40 to 0.44 (based on ovendry weight and green volume). In trees 3½ to 4 inches in diameter, crown ratios are mostly in the range from 30 to 60 percent, with average slightly less than 50 percent. Below-crown stem taper (inside bark) is generally more than 0.4 and less than 0.8 inch per 100 inches; it averages about 0.6 inch (table 9-1).

Table 9-1—Summary of data descriptive of the pair of trees 3½ to 4 inches in d.b.h. sampled from each of the 28 areas studied

Characteristic	Average	Standard deviation	Range
D.b.h. (outside bark), inches	3.74	0.175	3.26-4.05
Tree height (stump height to apical tip), feet	34.9	7.42	21.8-54.5
Tree age at stump height, years	87.0	38.46	24-240
Crown ratio, percent	46.4	15.81	14.7-81.8
Diameter inside bark			
Stump height, inches	3.84	0.211	3.32-4.28
20 percent of tree height, inches	3.33	0.184	2.82-3.75
Base of live crown, inches	2.54	0.441	1.80-3.45
Stem taper inside bark, inches/100 inches			
Below crown	0.60	0.169	0.30-1.44
Within crown	1.48	0.525	0.83-3.65
Height from stump top to crown base, inches	228	91.6	82-440
Properties of stemwood at 20 percent height			
Moisture content, percent ovendry weight	94.8	21.01	60-158
Specific gravity, ovendry weight and green volume	0.419	0.036	0.359-0.519
Rings/inch in first 1¼ inches radius	33.1	20.40	10-134
Spiral grain at surface, degrees	1.9	1.98	0-8
Pith eccentricity, inch	0.19	0.138	0-0.6
Bark thickness (single), inch	0.12	0.024	0.07-0.20
[1] Maximum crushing strength, thousand lb f/in^2	5.76	0.967	4.28-8.73
[1] Proportional limit, thousand lb f/in^2	3.85	1.039	1.06-6.08
[1] Modulus of elasticity, million lb f/in^2	1.19	0.320	0.64-2.09

[1]See appendix for procedure in obtaining these mechanical properties in compression parallel to the grain of 2¼-inch-diameter dowels (containing knots) at 10 percent moisture content.

In trees 3½ to 4 inches in d.b.h., stemwood moisture content at 20 percent of tree height averages about 95 percent of ovendry weight, with standard deviation of about 21 percentage points. At this height such trees have about 33 rings per inch in the first 1¼ inches of radius (standard deviation of 20 rings per inch), bark thickness of about 0.12 inch (standard deviation of 0.024 inch), spiral grain at the cambium layer of about 1.9° (standard deviation of 1.9°), and pith eccentricity of about 0.19 inch (standard deviation of 0.14 inch). For ranges in these properties, see table 9-1.

Mechanical properties of stemwood sections (taken from trees 3½ to 4 inches in d.b.h. at 20 percent of tree height to include knot clusters) air dried and turned to 2- by 14-inch-diameter dowels varied greatly from area to area, with specimens from Montana trees having highest values (see appendix 1). The 28-area average for modulus of elasticity was 1,190,000 lb f/in² (standard deviation of 320,000 lb f/in²), and the average for maximum crushing strength parallel to the grain was 5,760 lb f/in² (standard deviation of 967 lb f/in²). The foregoing values are for wood with moisture content of 10 percent of ovendry weight. Stem sections with visible compression wood averaged 26 percent lower in modulus of elasticity and 30 percent lower in maximum crushing strength parallel to the grain than those without visible compression wood.

Data from Montana lodgepole stands selected for 1985 thinning studies suggest that an average unthinned acre might contain 1,360 live stems 3 inches in d.b.h. and larger, totaling 3,400 ft³ of stemwood, or about 43 tons of stemwood (ovendry basis). Considering all of the 28 lodgepole pine stands visited, however, it seems that a more conservative estimate for lodgepole in the Rocky Mountain area might be 1,000 live stems per acre, 3 inches in d.b.h. and larger, totaling 2,500 ft³ of stemwood, or about 31 tons of stemwood, ovendry. When more accurate inventory data are available, even this lower estimate may prove too high.

On virtually all of the acreages, post-and-pole operators nibble away at the pole stands, each cutting 1 to 3 acres annually in close proximity to existing roads; such post-and-pole operations are sometimes used to achieve cosmetic thinning along these roads. These operators generally pay a stumpage fee of $5 to $10 per thousand lineal feet of product.

In Colorado and southern Wyoming acreages some lodgepole pine Christmas trees are cut annually (personal-use stumpage fee of $3 to $5 per tree). Almost all acreages have a significant market for dead stems sold as firewood ($2.50 to $12.50 per cord stumpage fee). Firewood stumpage values frequently exceed sawlog stumpage values.

Occasionally a sawlog sale of 15 to 500 acres is made, but virtually always at a stumpage cost less than that required to prepare the sale. Sawlog sales of more than 12,000 bd ft per acre are unusual, and stumpage fees usually are in the $6 to $10 range with some sales made at $1 per M bd ft Scribner log scale, and few as high as $25.

Costs of preparing and executing a small-acreage, low-volume sawlog sale, exclusive of road construction costs, vary greatly among forests and also depend on the characteristics of the sale area. Sale costs per thousand board feet of sawlogs are inversely related to sale acreage and to timber volume sold per acre. Sales on the areas studied usually encompass less than 40 acres, with lodgepole pine sawlog volume generally less than 8,000 bd ft per acre.

The direct costs to ranger districts (or equivalent on State or Bureau of Land Management forests) were reported as low as $2 in one area, but more typically are $12 to $25 per M bd ft Scribner scale. When all appropriate direct and indirect costs within ranger districts, supervisors' offices, and regional headquarters are included, however, total sales costs per thousand feet of lodgepole pine sold in small tracts appear to be in the range from $40 to $60, with one forest reporting total costs of $85. Such costs include not only those incurred by technicians, timber sales officers, and road planning engineers, but also those incurred by specialists in silviculture, wildlife habitat, landscape esthetics, watershed quality, archeology, and law (together with all supporting staff in supervisors' and regional foresters' offices).

Volumes of forest residues resulting from sawlog sales in these problem lodgepole pine stands are generally great because most of the sawlog operators have no profitable outlet for subsawlog-size stems.

MANAGEMENT OBJECTIVES AND SILVICULTURAL CONSIDERATIONS

With virtually no exceptions, the land managers have concluded that thinning these more-or-less stagnated stands that are 70 to 100 years old is an uneconomic procedure. This is so because products recovered in such thinning have low value, growth response is not outstanding, and thinning cost is great.

With almost no exceptions, the land managers are seeking some methodology to replace the stagnated and unmarketable stands of lodgepole pine with new vigorous stands of the same species—and they want to do this without expending public money. They visualize that this must be done by phased clearcutting and natural regeneration, but they have very few stumpage purchasers willing to build the necessary temporary roads, clear-fell all diameter classes of all species, and leave the acreage with no more than 25 tons (ovendry) of slash per acre and with sufficient seed distributed on exposed mineral soil to ensure natural regeneration. When the managers contract such stand replacement operations, they incur costs of $200 to $700 per acre—costs that they find hard to economically justify. Most of the managers do not find it necessary to plant such clearcut areas if the seedbed is properly prepared with mineral soil adequately exposed, and if viable seeds are available from serotinous cones on the ground or from adjacent trees bearing open cones.

Assuming that stand replacement can be accomplished with little or no expenditure of public funds, most of the managers think that they can internally fund thinning of the regenerated stands when the trees are 15 to 20 feet tall. Cost of such precommercial thinning is usually $60 to $85 per acre, but may be as high as $300 per acre where growth is dense.

In virtually all cases, the managers must give great consideration to improvement of wildlife habitat, protection of stream quality, and protection of esthetic values—but these considerations are not generally seen as prohibiting

planned stand replacement as long as clearcuts do not exceed 40 acres, are spaced to maintain elk or deer hiding cover, do not disturb streams, and are located and contoured to be visually acceptable. This generalization does not apply to two or three of the Wyoming-Colorado areas where recreational use is heavy and where hiding cover for elk is limited to a narrow forest of lodgepole pine bordered by sagebrush below the trees and exposed rock above.

While controlled or wild fire might appear to offer a solution on some acreages, few managers are willing to embrace the idea of deliberately wasting the enormous tonnages of wood that would be consumed by such fires. And such fires would offer limited scope for protecting stream quality, habitat, and esthetic quality of the forest.

MANAGEMENT IMPLICATIONS

In brief, the land manager faces the problem of how to clearcut and regenerate large acreages of stagnated or otherwise unproductive stands of lodgepole pine without expenditure of public funds to cover the direct costs. Managers must accomplish this stand replacement according to a management plan without jeopardizing the other values of the forest—wildlife habitat, stream quality, and esthetic quality. Such stand replacement with vigorous new stands is done in contemplation of thinning to a prescribed stocking density when the new trees attain a height of about 15 to 20 feet. Biomass resulting from the clearcuts should yield a positive contribution to the economy—as contrasted to waste through destruction by fire or by insects and disease.

At the same time, the industrial manager of the manufacturing operation performing the clearcuts, site preparation, and utilization of the material removed faces the problem of making an appropriate profit on investment in harvesting, transport, and conversion facilities. This after-tax return should be at least 15 percent annually on the entire investment, assuming no borrowed funds.

APPENDIX: PROCEDURE AND RESULTS OF COMPRESSION TESTS

One of the most promising uses of small-diameter lodgepole pines is as pith-centered dowels for structural purposes (Koch and Burke 1985). The 56 trees sampled (dominant and codominant where possible) were selected in a narrow range of diameters from 3½ to 4 inches in d.b.h. Because this diameter class represents a major unutilized portion of most lodgepole pine forests, and because trees from this size class can be used in the joists described by Koch and Burke (1985).

Procedure

To provide some statistical data descriptive of mechanical properties of such dowels, a 9-inch-long stem section was removed at 20 percent of tree height from each of the 56 trees. This height was selected because previous research (Koch 1987) showed that the specific gravity of stemwood sampled at 20 percent of tree height closely approximates the average for entire stemwood.

These stem sections were debarked, air dried, lathe-turned to 2¼ inches in diameter, and square-end trimmed to remove chuck marks.

All but two of the turned specimens (Caribou-1 and Gallatin-1) included knot clusters. No knots exceeded 0.5 inch in diameter, and most measured 0.2 to 0.3 inch in diameter. Most were sound red knots, but some were encased.

At test, the specimens averaged 8.2 percent moisture content (based on ovendry weight), with standard deviation of 0.63 percentage point and range from 6.4 to 9.5 percent. Of the 56 specimens, 30 had at least one drying check and 26 were check free.

Compression wood—usually formed by accelerated growth on the lower side of inclined stems, and causing an eccentric pith—was readily visible in 14 of the 56 specimens, as follows. The terms "slight," "significant," and "much" denote increasing degrees of compression wood presence (fig. AP-1):

Colorado	
Gunnison-1	(slight)
Gunnison-2	(slight)
BLM-2	(slight)
Idaho	
Challis-1	(slight)
Challis-2	(slight)
Panhandle-1	(significant)
Panhandle-2	(significant)

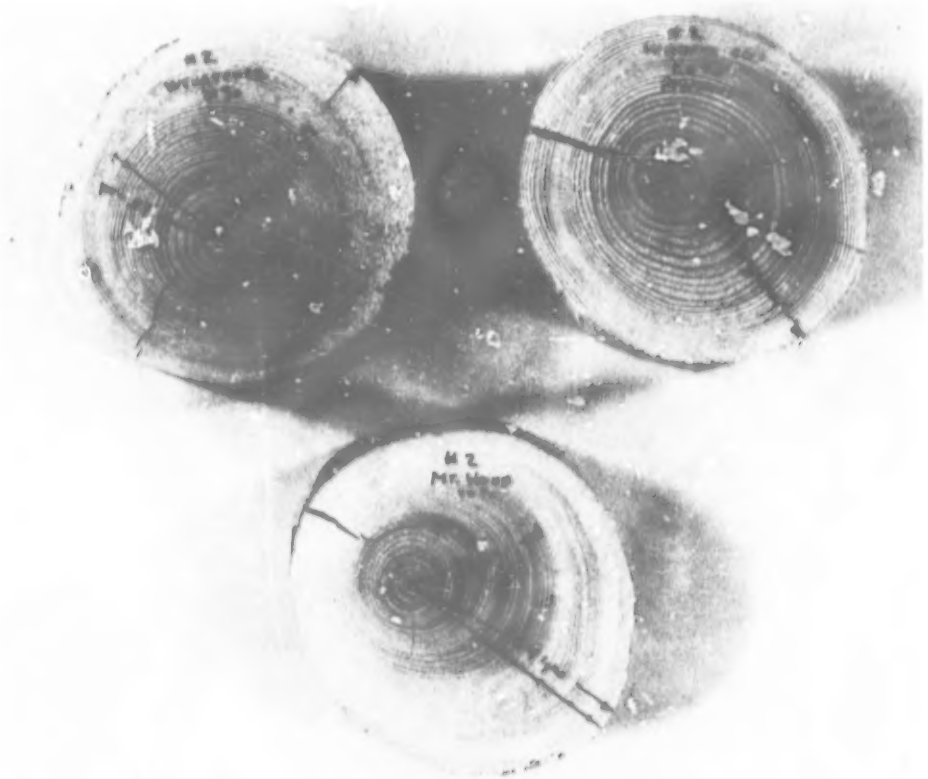

Figure AP-1—Three degrees of compression-wood presence in specimens taken at 20 percent of tree height. (Top left) Slight. (Top right) Significant. (Bottom) Much. The specimens are about 3.4 inches in diameter.

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Oregon	
Fremont-1	(slight)
Fremont-2	(significant)
Mount Hood-1	(much)
Mount Hood-2	(much)
Washington	
Wenatchee-2	(slight)
Wyoming	
Bridger-Teton-2	(slight)
Shoshone-2	(slight)

Compression tests parallel to the grain were conducted according to ASTM D-198 (ASTM 1972a) on the 60,000-pound universal testing machine of the University of Montana School of Forestry. The machine was fitted with a compressometer with 4-inch gauge length and dial gauge reading to 0.0001 inch. Moisture content at test and specific gravity (based on ovendry weight and volume at test) were determined. The compressometer was placed so that the knot cluster present in each specimen (except Caribou-1 and Gallatin-1, which were knot-free) was within the gauge length.

Values for modulus of elasticity, maximum crushing strength, and proportional limit were adjusted to a specimen moisture content of 10 percent by the procedure specified in ASTM D-2915 (ASTM 1972b).

Results

Mechanical properties, in compression parallel to the grain, of the 56 specimens gathered from the 28 areas in seven States are summarized as follows (values adjusted to a specimen moisture content of 10 percent of ovendry weight):

Property	Average value	Standard deviation	Range
		Lb f/in²	
Modulus of elasticity	1,190,000	320,000	640,000-2,090,000
Maximum crushing strength	5,760	967	4,280-8,730
Proportional limit	3,850	1,039	1,060-6,080

The data (table AP-1, summarized by State in table AP-2) suggest that mechanical properties in compression parallel to the grain are not closely related to specific gravity, rings per inch, or the presence of drying checks.

Table AP-1—Characteristics of 56 stem sections sampled at 20 percent of tree height, air dried, lathe-turned to 2¼ inches in diameter, and tested in compression parallel to the grain

Specimen number	Compression wood[1] content	Modulus of elasticity	Maximum crushing strength	Proportional limit	Specific gravity[2]	Rings per inch[3]
		Million lb f/in²	*Lb f/in²*	*Lb f/in²*		
			COLORADO			
Gunnison-1	slight	0.95	5,770	4,270	0.460	112
Gunnison-2	slight	1.33	6,410	5,110	.507	134
Rio Grande-1		.97	5,790	3,610	.477	48
Rio Grande-2		.87	5,250	4,140	.443	36
White River-1		1.15	5,660	3,830	.453	40
White River-2		1.15	6,270	4,640	.494	48
State Forest-1		1.47	6,330	5,500	.467	38
State Forest-2		1.03	5,160	4,540	.449	30
BLM-1		1.06	5,270	3,970	.468	46
BLM-2		1.12	4,900	3,760	.441	30
Average		1.11	5,690	4,337	.466	56.2
Standard deviation		.180	518	613	.022	36.2
			IDAHO			
Caribou-1		1.16	5,930	4,260	0.396	13
Caribou-2		1.22	5,360	3,710	.372	17
Challis-1	slight	.64	4,410	2,280	.419	19
Challis-2	slight	.97	5,550	3,720	.447	24
Nezperce-1		1.42	5,370	3,980	.471	14
Nezperce-2		1.52	6,100	5,120	.467	13
Panhandle-1	significant	.64	4,510	2,720	.428	14
Panhandle-2	significant	1.02	5,060	1,830	.519	14
Payette-1		.98	5,920	4,440	.475	24
Payette-2		1.10	5,910	2,990	.479	28
Salmon-1		.90	5,390	3,230	.426	47
Salmon-2		.98	4,530	2,020	.434	18
Average		1.05	5,336	3,408	.444	20.4
Standard deviation		.27	597	968	.040	9.7

(con.)

Table AP-1 (Con.)

Specimen number	Compression wood[2] content	Modulus of elasticity	Maximum crushing strength	Proportional limit	Specific gravity[3]	Rings per inch[4]
		Million lb/in.²	*Lb/in.²*	*Lb/in.²*		
			MONTANA			
Deerlodge-1		1.50	6,150	3,500	0.438	27
Deerlodge-2		1.46	6,890	4,160	.432	35
Flathead-1		1.37	6,460	4,550	.494	25
Flathead-2		1.42	5,910	4,530	.451	22
Gallatin-1		1.57	7,900	6,080	.485	37
Gallatin-2		1.80	8,700	5,220	.534	40
Helena-1		1.35	5,990	4,590	.487	42
Helena-2		1.86	7,240	5,300	.479	32
Kootenai-1		1.87	7,190	5,760	.499	29
Kootenai-2		2.09	8,730	5,590	.559	30
Average		1.63	7,116	4,928	.492	31.9
Standard deviation		.26	1,048	798	.035	6.5
			OREGON			
Fremont-1	slight	0.84	5,410	2,830	0.520	33
Fremont-2	slight	.74	4,390	2,290	.445	34
Malheur-1		1.46	6,650	3,590	.452	19
Malheur-2		1.02	5,070	3,570	.460	26
Mount Hood-1	much	.80	5,080	1,860	.570	32
Mount Hood-2	much	.71	5,180	1,060	.590	26
Average		.93	5,297	2,533	.506	28.3
Standard deviation		.28	745	996	.063	5.8
			UTAH			
Ashley-1		1.06	5,060	2,810	0.410	46
Ashley-2		.97	5,190	3,950	.415	24
Average		1.02	5,125	3,380	.413	35.0
Standard deviation		.06	92	806	.004	15.6
			WASHINGTON			
Colville-1		0.96	4,280	3,110	0.389	10
Colville-2		1.33	5,350	4,110	.412	13
Okanogan-1		1.47	6,200	3,510	.465	48
Okanogan-2		1.71	7,030	5,270	.512	28
Wenatchee-1		1.27	6,050	4,500	.422	34
Wenatchee-2	slight	1.14	5,480	3,740	.460	20
State Forest-1		.95	5,130	3,620	.430	19
State Forest-2		1.08	5,220	3,850	.446	25
Average		1.24	5,593	3,969	.442	24.6
Standard deviation		.26	827	668	.038	12.2
			WYOMING			
Bighorn-1		1.11	5,130	3,060	0.470	40
Bighorn-2		1.19	5,350	3,690	.463	42
Bridger-Teton-1		.88	4,940	2,890	.424	37
Bridger-Teton-2	slight	.78	4,510	2,720	.404	31
Medicine Bow-1		1.16	5,500	4,120	.472	32
Medicine Bow-2		1.42	6,230	4,520	.452	32
Shoshone-1		1.16	5,000	3,190	.467	42
Shoshone-2	slight	1.43	6,770	4,170	.472	28
Average		1.14	5,429	3,545	.453	35.5
Standard deviation		.23	738	672	.025	5.5

[1]Mechanical properties tabulated adjusted to a specimen moisture content of 10 percent of ovendry weight.
[2]See figure AP-1 for definition of terms.
[3]Specific gravity based on volume at test (8.2 percent moisture content) and ovendry weight.
[4]Average for the test specimen.

Table AP-2—Test-specimen characteristics tabulated by State averages and ranked by modulus of elasticity; standard deviations shown in parentheses

State	Number of specimens	Modulus of elasticity	Maximum crushing strength	Proportional limit	Specific gravity	Rings per inch
		Millic.n lb f/in.²	*Lb f/in.²*	*Lb f/in.²*		
Montana	10	1.63	7,120	4,930	0.492	32
		(.26)	(1,040)	(798)	(.035)	(7)
Washington	8	1.[illegible]	[illegible],590	3,970	.442	25
		(.26)	(827)	(668)	(.038)	(12)
Wyoming	8	1.14	5,430	3,550	.453	36
		(.23)	(738)	(672)	(.025)	(6)
Colorado	10	1.11	5,690	4,340	.466	56
		(.18)	(518)	(513)	(.022)	(36)
Idaho	12	1.05	5,340	3,410	.444	20
		(.27)	(592)	(968)	(.040)	(10)
Utah	2	1.02	5,130	3,380	.413	35
		(.60)	(92)	(806)	(.004)	(16)
Oregon	6	.93	5,300	2,530	.506	28
		(.28)	(745)	(996)	(.063)	(6)

This lack of correlation with specific gravity is largely attributable to the presence of knot clusters in the specimens and, more importantly, to the sporadic presence of compression wood. Compression wood generally has high specific gravity, but—in dry wood—low mechanical properties. Also, trees that are fast growers may have more compression wood than the slow growers. For example, the two trees sampled from the Pinhead Butte area of the Mount Hood National Forest both had much compression wood and had average modulus of elasticity of only 760,000 lb f/in² with proportional limit of only 1,460 lb f/in² even though they had the highest specific gravity of any trees sampled (average 0.580); these two specimens had 32 and 23 rings per inch.

Differences in mechanical properties between specimens free of compression wood and those with compression wood readily visible in sanded cross sections are indicated in the following tabulation:

Property	No visible compression wood (42 specimens)	Visible compression wood (14 specimens)
	Lb f/in²	
Modulus of elasticity		
Average	1,270,000	940,000
Standard deviation	299,000	250,000
Range	870,000-2,030,000	640,000-1,430,000
Maximum crushing strength		
Average	5,920	5,250
Standard deviation	986	722
Range	4,280-8,730	4,390-6,770
Proportional limit		
Average	4,130	3,030
Standard deviation	855	1,134
Range	2,620-6,080	1,060-5,110

Readers interested in a definitive treatise on compression wood will find useful Timell's (1986) three-volume work on the subject.

While data are far from adequate to characterize small lodgepole pines in the several States studied, particularly those of Utah where only two trees were sampled, a ranking of the States by specimens' average modulus of elasticity suggests that lodgepole pines in Montana's study areas have superior mechanical properties (table AP-2).

As an aid to material-balance computations for doweling plants, it is useful to note that for every pound of doweled 2¼-inch-diameter specimen produced, the shavings from the turning operation weighed 0.97 pound. Bulk density of the shavings (lightly packed, and at a moisture content of 8.2 percent of ovendry weight) was 9.6 pounds per cubic foot.

Table 9-1 indicates that the average inside bark diameter at stump height of the sample trees was 3.84 inches, and at the base of the crown it was 2.54 inches; height from stump top to crown base averaged 289.23 inches. A 2¼-inch-diameter dowel taken from the frustrum of a cone with these dimensions would represent 49.1 percent of the volume of the entire cone frustrum—a percentage nearly equal to the ratio of cross-sectional area of the dowel to the average cross-sectional area of these 56 sample stems at 20 percent of tree height (45.8 percent).

In brief, woody residues from doweling bark-free stems of this size should about equal the weight of 2¼-inch dowels produced.

REFERENCES

American Society for Testing and Materials [ASTM]. 1972a. Standard methods of static tests of timbers in structural sizes. ASTM Designation D-198.

American Society for Testing and Materials [ASTM]. 1972b. Evaluating allowable properties for grades of structural lumber. ASTM Designation D-2915.

Koch, Peter. 1987. Gross characteristics of lodgepole pine in North America. Gen. Tech. Rep. INT-227. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 311 p.

Koch, Peter; Burke, Edwin J. 1985 Strength of fabricated joists with flanges of minimally machined whole or half stems of lodgepole pine. Forest Products Journal 35(1): 39-47.

Timell, T. E. 1986. Compression wood in gymnosperms. Berlin: Springer-Verlag. 2150 p. 3 v.

☆ U.S. GOVERNMENT PRINTING OFFICE:1988-573-039/81000

Koch, Peter; Barger, Roland L. 1988. Atlas of 28 selected commercial forest areas with unutilized stands of lodgepole pine. Gen. Tech. Rep. INT-246. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 171 p.

This atlas provides maps and general descriptions of a single representative problem area of more-or-less contiguous acreage within each of 28 public forests (National, Bureau of Land Management, and State) where increased utilization of lodgepole pine is desired by the forest manager. The 28 areas total 646,401 acres. Most of the lodgepole pine volume is of subsawlog size.

KEYWORDS: Colorado, forest policy, harvesting, Idaho, mechanical properties, Montana, Oregon, *Pinus contorta*, public forests, resource data, Sierra lodgepole pine, silviculture, stand replacement, stumpage value, tree dimensions, Utah, Washington, Wyoming

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